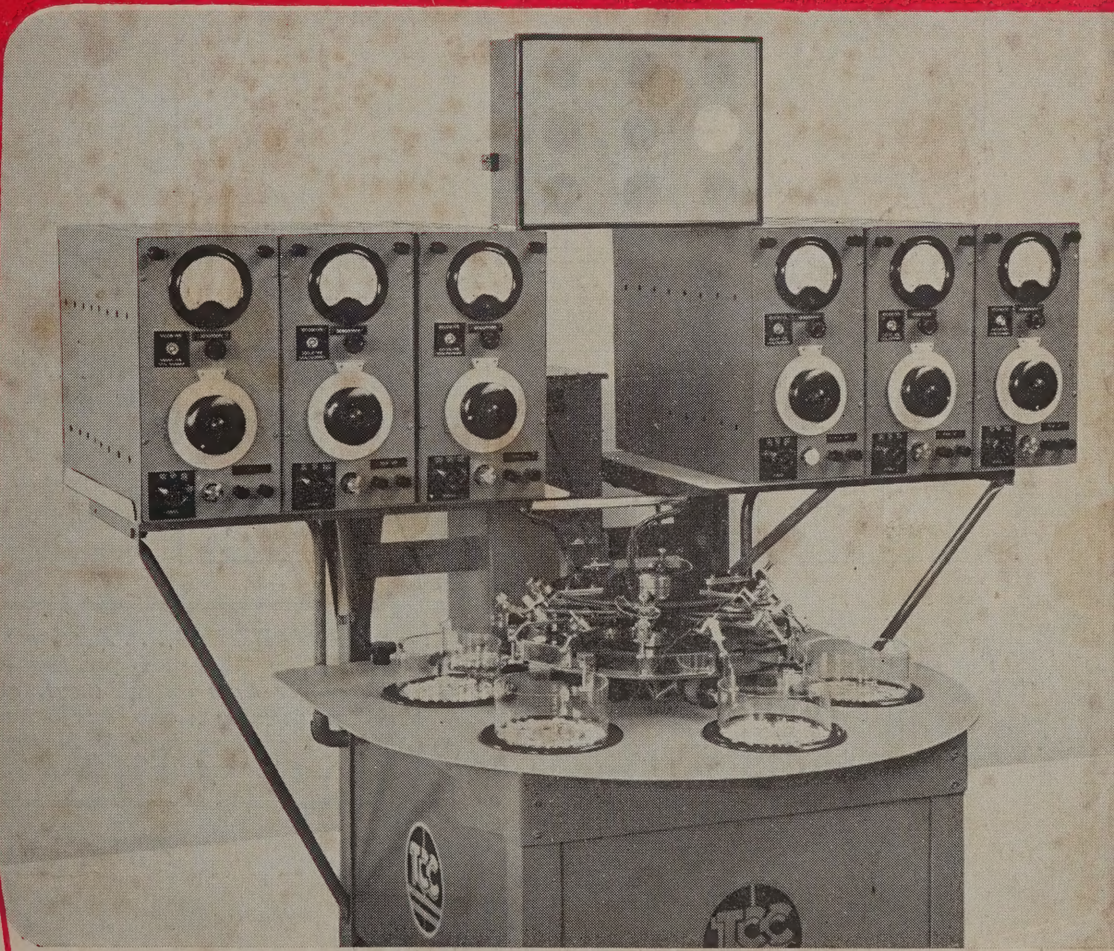
RADIO and ELECTRONICS

ELECTRICITY —— COMMUNICATIONS —— SERVICE —— SOUND



SEPTEMBER, 1st, 1953 VOL. 8, NO. 7

Registered at the G.P.O., Wellington, for transmission by post as a newspaper.

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Radio and Electronics

OUR COVER:

Shows equipment designed to measure and automatically sort ceramic condensers into the appropriate values for labelling to a specific tolerance.

Official Journal of
The N.Z. Electronics Institute (Inc.).
The N.Z. Radio and Television Manufacturers' Federation.
The N.Z. Radio Traders' Federation.

Managing and Technical Director:
W. D. FOSTER, B.Sc.

Subscriptions:
1s. 10d. per copy; 23s. 6d. per annum, posted.
Advertising Rates supplied on application.

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46 Mercer Street, Wellington.
Telephone, Wellington, 70-216.
Telegrams and Cables:
"Radel," Wellington.

SOLE ADVERTISING REPRESENTATIVES for THE UNITED KINGDOM:
Cowlishaw and Lawrence (Advertising), Ltd., 28 New Bridge Street, London, E.C.4.
Telephone City 5118.
Cables: Cowlawads Cent, London.

VOL. 8, No. 7 1st SEPTEMBER, 1953

Contents

Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington

PRINTED BY HARRY H. TOMBS, LTD., WINGFIELD STREET, WELLINGTON.

STILL NO TV POLICY

It is now many moons since the Government set up a special consultative committee to look into, and to advise the Government on certain aspects of the introduction of television into this country. It is not so long, but still a long time, since a sub-committee of Cabinet was established with the idea of formulating Government policy with regard to TV; and even yet we have no announcement of the Government's policy, or even any indication that after all this time it has one. From the radio industry's point of view, there is little need to stress here how unsatisfactory this state of affairs is. The thing is far from being a joke, any yet by refusing to commit itself to any policy, the Government implies at least that it is a matter of little public importance. We do not believe for a moment that this is so. A number of people have expressed the view that television is an expensive luxury which New Zealand cannot efford, but since when has entertainment, within reason, been purely a luxury? The argument that we should not have TV because it costs money, and because we have numerous enough ways of entertaining ourselves without it, is in no wise different from the grumblings of some spoil-sport greybeard that, "In my day there weren't any picture theatres to go to, and no radio to listen to. We had to make our own entertainment—and very much better we were for it too." This argument has always seemed to us to smell of sour grapes, and to prove nothing. It is no more than a variation on the theme, "I don't hold with these here hossless carriages."

Let us look for a moment at the question of expense. Television, like many undertakings, is expensive in terms of capital outlay—if one likes to make it so. It is also expensive to run—again if you like to make it that way. It has yet to be proved that it is impossible to put on acceptable TV programmes on a small budget, and it has been proved that relatively small communities can and do support commercial TV stations. This, of course, is in America, where advertising is bigger business, relatively speaking, than anywhere else in the world, but numerous examples exist of TV stations serving considerably smaller communities than those of our main centres, and doing it at a profit. If this is so, it proves that economically, commercial television is possible for New Zealand. Whether or not one believes that television should be saved from commercialized use is another matter altogether, and purely one of personal preference.

Those who have expressed themselves as not in favour of television being introduced have also used the argument that there is no public demand for it. For that matter, nor was there any public demand for the introduction of motor transport, or railways, or broadcasting, or many of the features of present-day life which we now consider as necessities. No one these days looks upon a radio set as a luxury. It is something which a young couple setting up house would no more think of doing without than they would tables and chairs. Radio broadcasting, in short, has become an integral part of our everyday life. It may well be that in the future, television broadcasting will reach a similar status. Here again, our views on whether such an eventuality would be a good thing, or the reverse, are immaterial to the present argument. Television is no longer new, having made its debut as a medium of home entertainment in Britain in 1937—sixteen years ago. Why, then, should any Government purposely hold up natural development, to the extent of refraining, for what is now a period of years, from making up its mind as to how television shall be commenced. That is all they are asked to do. No one has said that the Government should itself set up television broadcasting. The situation is merely this; in these bureaucratic days, it is impossible to do anything so far-reaching as setting up a television service, of any sort, without first having obtained a licence to do so. It is even futile to apply for a licence, because the authority which would have to issue the licence has no Government policy to implement with regard to TV, and if it referred such an application to the Government, the latter would certainly refuse to grant the licence, having no policy itself, whereby to establish a precedent. All the radio industry has been asking the Government to do is to have a policy on TV. So far, all that anyone has been able to extract is the information (hardly news) that no policy exists. It begins to look very much as if the Government is afraid of television. Not of the thing itself, that is, but of having a policy about it. In Australia, TV has been hurled back and forth between the parties like a medicine ball, and it looks as if our Government has decided that it is bad medicine at that. They are perhaps afraid that whatever their policy on TV, the Opposition would use it as a stick with which to beat them. Nor would it surprise us to find out that the Opposition secretly feels the same way about it. If we pride ourselves on having become a nation, albeit a youthful one, then the least we can do to prove it is to refrain from acting the ostrich with regard to a development which is of major importance to a very considerable industry, and which will certainly arrive upon us sooner or later, irrespective of any efforts to delay the event.

A Design for a High-Quality Audio System

In the July issue of Radio and Electronics, *we presented an introductory article describing a scheme for a new high-fidelity amplifier system. The continuation, presented here, describes the features and circuit of the main amplifier.*

In attempting to design an amplifier which will have features in some degree at least improving on those of the well-tried Williamson circuit, we have set ourselves quite a task. However, some very interesting work has resulted, and we hope that readers will find this article as interesting as we found the development of it.

SUMMARY OF FEATURES

First of all, let us give in brief outline some of the features and properties of the amplifier whose circuit appears on the next page. In the first place, in order to make things easier for those wishing to duplicate the original amplifier, we have specified the use of an output transformer built to Williamson's specifications, or better. As this has been done, there seemed little point in going past the KT66 as the output valve. So far, at least, it looks as though we are doing nothing but duplicate someone else's results, but except for one point, there the similarity ends. The unusual features of the circuit may be summarized as follows:—

(1) The driver stages employ double triodes as cathode-coupled pairs, with the "free" grids used for injecting feedback voltages from the plates of the output valves. These feedbacks form the secondary loops indicated on the block diagram given in the first part of this series.

(2) The phase inverter is a further cathode-coupled stage.

(3) The main voltage amplifier is a pentode, direct-coupled to the phase inverter, as in Williamson's circuit, in order to reduce phase shift at low frequencies.

(4) A 12J7 is used as the pentode, because of its filament current of 150 ma. In order to achieve an exceptionally low hum level, the heater of this valve is fed not from an A.C. winding on the power transformer, but by placing it in series with the negative H.T. lead to the power supply. The pure D.C. heater current removes altogether a prolific source of hum, and results in a remarkably hum-free output.

(5) As might be guessed from the valve line-up, the overall gain of the amplifier, even with a very large degree of negative feedback, is considerably greater than that of many high-quality amplifiers, being enough to give it a sensitivity of approximately 0.2 volts for full output.

(6) Because of the two feedback loops, the total feedback round the output stage can be raised to over 42 db. without instability setting in. For an amplifier with such a high overall gain, this can be reckoned as somewhat of an achievement, although it is not recommended that the amplifier be operated with this great amount of feedback.

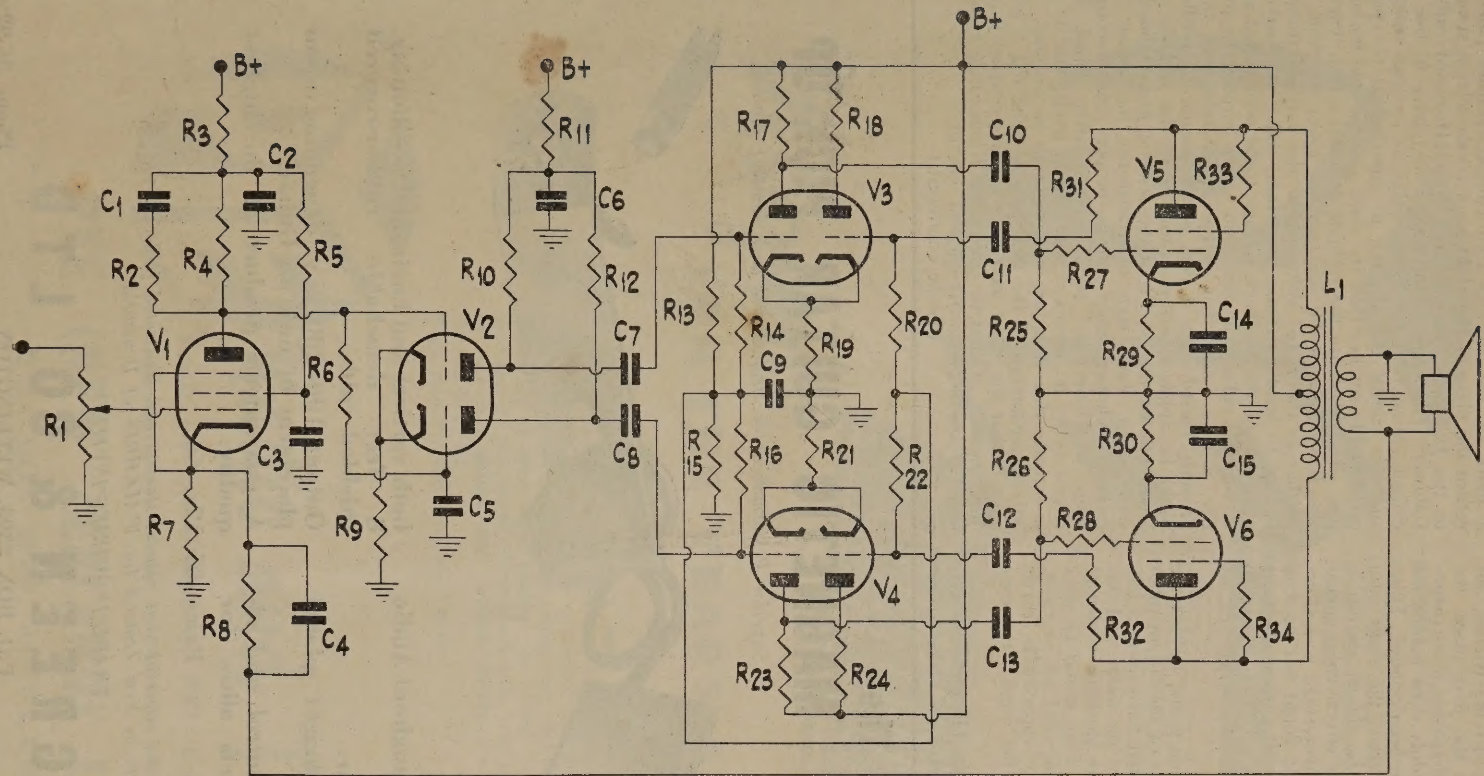
(7) Because of the high gain, it will be possible to feed the amplifier directly from a high-level, high-quality, pick-up followed by an equalizer network. That is to say, with such a pick-up, no pre-amplifier stage would be necessary. By the same token, the amount of pre-amplification needed by the low-level pick-ups in popular use today will be considerably less than is required when less sensitive amplifiers are used.

This list gives some idea of the novelty of the amplifier, even though it makes no pretence to originality, and on the contrary, clearly owes much to the Williamson circuit in particular. No mention has been made of the available power output, it will no doubt have been noticed, but this is because the power made available can be varied within quite wide limits, depending on the H.T. voltage that is appleid to it.

CIRCUIT FEATURES IN DETAIL

Starting at the speaker, and progressing backwards through the circuit, the first point to note is the unconventional driving arrangement for the output tubes, together with the internal feedback loops. The method by which this circuit was arrived at may be of some interest.

The difficulty, of course, is to devise a suitable method of applying feedback over the two stages without introducing critical components. It would be possible, in theory at least, to take the feedback from the plates of the



COMPONENT LIST

R_1, 500k. volume control.
R_2, 2.5k.
R_3, R_{10}, R_{12}, R_{17}, R_{18}, R_{23}, R_{24}, 100k.
R_4, R_{20}, R_{22}, 25k.
R_5, 200k.
R_6, 1 meg.
R_7, 500 ohms.
R_8, main feedback resistor, see text.
R_9, R_{19}, R_{21}, 60k.
R_{11}, 20k.
R_{13}, 1.25 meg.
R_{14}, R_{16}, 1 meg.
R_{15}, R_{25}, R_{26}, 500k.
R_{27}, R_{28}, 10k.
R_{29}, R_{30}, 600 ohms 5 watts.
R_{31}, R_{32}, feedback resistors, see text.
R_{33}, R_{34}, 100 ohms.
C_1, 500 $\mu\mu$f.
C_2, C_6, 16 μf. 450v. electro.
C_3, 0.01 μf.
C_4, feedback condenser, see text.
C_5, C_{11}, C_{12}, 0.5 μf.
C_7, C_8, C_{10}, C_{13}, 0.1 μf.
C_9, 0.5 μf.
C_{14}, C_{15}, 50 μf. 50v. electro.
V_1, 12J7 or 12J7GT.
V_2, V_3, V_4, ECC32.
V_5, V_6, KT66.
L_1 (should be T_1) Williamson Output Transformer, 9000 ohms to 15 or 4 ohms.

output tubes to the cathodes of the driving triodes, but this would have disadvantages. In the first place, the cathode resistor would have to be unbypassed, thus reducing the gain of the driver stage unduly even before the feedback from the output stage had been applied. Thus, by the time this feedback was effective, the stage gain of the drivers would be reduced to almost negligible proportions, thereby neutralizing their effectiveness almost entirely. Even if the gain of the driver stage was effectively reduced to unity, however, it could not be said that the drivers were serving no useful purpose, because their amplification would have been taken up in applying feedback to the output stage, thereby decreasing its distortion.

Another disadvantage of the scheme would be that the feedback resistors, between the plates of the output tubes and the cathodes of the drivers would have quite a low value, owing to the low stage gain of the latter, and this in turn would necessitate a very large blocking condenser at the plate of each output valve. This would be poor practice, since a very large condenser of 1 μf. or more, would inevitably have a high stray capacity to earth, and this would tend to reduce the high frequency response.

An alternative would be to use roughly the same circuit as has been done here, but to give the driver triode a more or less normal-sized cathode resistor, and to return the plate of the right-hand triode section straight to the H.T. line, making it a straightforward cathode follower. The cathode follower would have to use the cathode resistor of the driver valve as its load resistor, and this causes the resistor in question to be chosen considerably smaller than the same valve would normally use, simply because the cathode follower's plate current also flows through the resistor. The lower its value, the smaller is the signal voltage that the cathode follower is able to handle without distortion, and it is clearly as essential for the feedback voltage to be undistorted as it is for the voltage in the main signal circuit. In practice, it was found that if the driver tube was to be properly biased, only a very small amount of feedback could be applied before distortion in the cathode follower limited things. From the scheme just outlined, it was but a short step to transform the driver and cathode follower stage into a proper cathode-coupled stage, or "long-tailed pair" as it is often called. This circuit is by no means a new one in itself, but its use in exactly this situation is thought to be original. The only disadvantage of the final scheme—and not a grave one—is that the stage gain of a cathode-coupled pair is only one-half of that of one of the triodes in a conventional resistance-capacity-coupled circuit.

(To be continued.)

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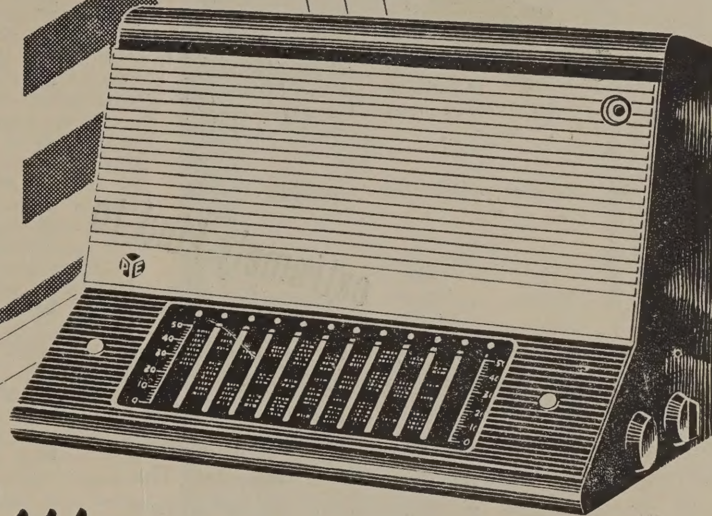

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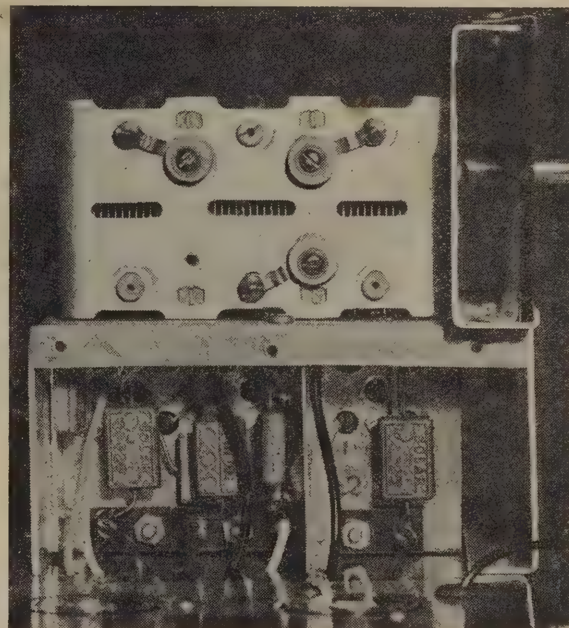
A Five-Valve Receiver With An R.F. Stage

The first part of this article, published in last month's issue of Radio and Electronics, *described the circuit and gave working drawings for the chassis and sub-chassis of this high-performance five-valve broadcast set. This month we complete the description with some constructional hints.*

CONSTRUCTION

The two photographs printed here show all the necessary constructional details. First of all, and most important, is the manner of mounting the aerial, R.F., and oscillator coils on the sub-chassis. The photograph on this page is a view looking into the sub-chassis from the left-hand side of the set. It shows the gang condenser, with its built-on dial assembly, screwed to the top of the coil box, and also the wiring from the coils' connecting lugs to both the gang, and to the rest of the circuit, underneath the chassis. The first point to note is that the coils, in their small rectangular cans, are mounted close to the top edge of the sub-chassis, in a straight line, each coil being directly underneath its own gang section. In the foreground of the picture can be seen the sockets of the R.F. and mixer valves. The one at the right, which is nearest the front of the chassis, is the R.F. stage, and the other is the ECH21. The coil nearest the front is, of course, the aerial coil, but it is not obvious from the photograph that the middle coil is the oscillator one, and the back one, the R.F. This is an excellent arrangement—much better than placing the R.F. coil next to the aerial coil. It allows the oscillator section of the gang condenser to be a shield between the two coils carrying signal frequencies and thus helps materially in avoiding instability. Note too, that we have placed a small baffle shield between the aerial and oscillator coils, as a further precaution against feedback from the mixer into the R.F. stage's wiring. It is probable that the set would be quite stable without this shield, but we are unable to say whether this is definitely so, because in the prototype we did not try the effect of omitting the shield. However, it is good practice to include it, and we do not recommend intending builders to leave it out.

Note, too, that in order to terminate the leads tidily, and also to have tie-points to which the grid condensers may be firmly attached, three small insulating strips, each carrying solder lugs, have been mounted along the bottom of the compartment. The ones we used ourselves were made by riveting three connecting lugs on to small pieces of fibre, and mounting them with nuts and bolts. In order to prevent the connecting lugs from shorting to the chassis, the bolts were put through, and nuts were screwed down to the chassis. The strips were then put on over these nuts, which act as spacers, and then held down by the nuts which can be seen in the photograph. Four small mica condensers can be seen, and a portion of a fifth. The one at the extreme right is the grid condenser of the R.F. stage. It is mounted at one end on the solder lug provided as described above, and at the other end on the appropriate connecting lug on the coil base. This lug is also connected by a short wire to the stator of the gang section. This wire cannot be seen, being hidden under the turned-down flange in the photo. The end of the blocking condenser which is connected to the insulated lug (i.e., the lower end in the picture) is connected by a wire which goes through an ⅛ in. hole in the chassis by as direct a route as possible to the grid pin of the EF22. A further point to note is that the grid leak resistors in all three cases are mounted at the valve sockets, right on to the appropriate valve lugs. They are therefore not found inside the coil box. Indeed,

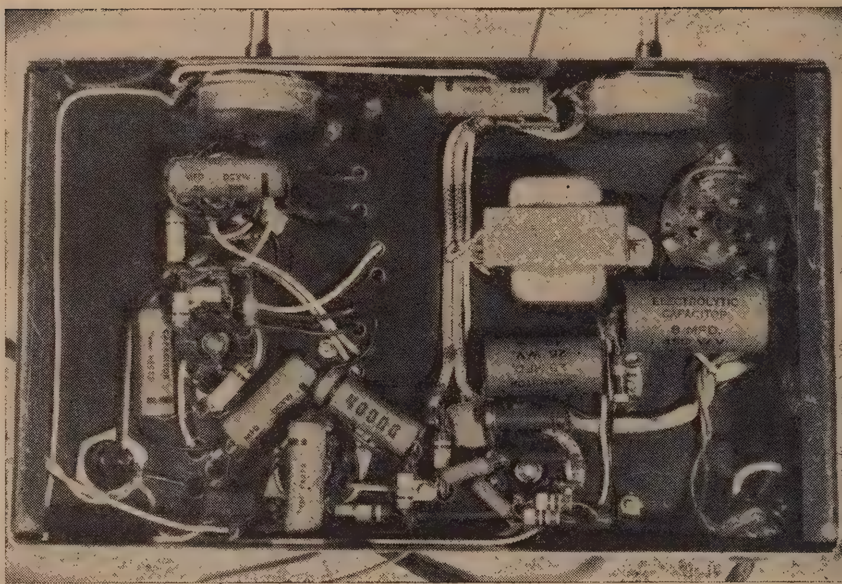


This photograph shows the interior of the coil-wiring compartment. The coils themselves are mounted in their cans on the other side of the side wall of the box, and all wiring between the gang, the coils and the rest of the set is accessibile by removing the lid of the box, as shown. In the foreground can be seen the sockets of the R.F. and mixer stages.

the only components in here are the five mica condensers previously mentioned. The grid condenser for the mixer can be seen at the extreme left of the photo, also with its lead going through a hole in the chassis to the ECH21 grid pin. This leaves the three condensers associated with the oscillator circuit. The one on edge is the plate blocking condenser, the other is the grid blocking condenser, and the third, partially hidden, is the padder. Unlike most padders, this is a fixed condenser, and no adjustment of it is either possible or necessary. The reason for this is that the oscillator coil is provided with a tuning slug which enables its inductance to be varied. Now a superhet can be aligned just as well by using a fixed padder condenser and a variable-inductance oscillator coil as by the more usual method of fixing the coil inductance and using a variable padder. Because of this, the constructor need have no fear that the unfamiliar arrangement will be more difficult to align. The correct padder condenser can be provided by the maker of the coils, and since the padder needs to be correct to within quite fine limits, it is as well to purchase the padder at the same time as the oscillator coil.

In the photograph the two earthing leads from the

gang condenser can be clearly seen. They are the two black leads coming down from the gang wipers, across the coil box and through the chassis. The one from the wiper between the two front gang sections is taken to the R.F. valve socket, where it is earthed, while the other one is earthed at the mixer socket.



The rest of the set needs little comment. The construction is quite conventional in all respects. The leads to and from the volume control are run in shielded wire, but those to the tone control are not. This can be done because the 500 $\mu\mu$f. plate bypass condenser on the output stage is connected right at the socket, thereby effectively removing any I.F. voltage that may appear there. One lead from the tone control potentiometer, which is also the grid leak for the output stage, comes from the volume control potentiometer, and so is not very long, but the other travels right round the left-hand edge of the chassis, avoiding the rest of the circuit as far as possible. The 100 $\mu\mu$f. blocking condenser is mounted at the plate of the output stage.

ALIGNMENT

One word of warning is necessary about the alignment of this set. It will be noticed that not only the oscillator coil, but the aerial and R.F. ones too, are provided with tuning slugs. These are pre-set at the factory, and should be left severely alone. In other words, the aerial and R.F. coils should be treated just as though they had no slugs at all. If this is done, alignment consists of no more and no less than is necessary when other coils are used, the only exception being that the oscillator coil's inductance is varied for adjusting the padding at the low-frequency end of the dial instead of the padder capacity, which is fixed. The set should be aligned with the aerial connected which it is proposed to use.

PUBLICATIONS RECENTLY RELEASED

Rider's "How to Use" Series of Books Highlight Test Equipment

John F. Rider Publisher, Inc., 480 Canal Street, New York 13, N.Y., is starting a brand new series of practical "how to use" books. The first three titles in this series published in July are *How to Use Signal Generators, How to Use Meters,* and *Obtaining and Interpreting Test Scope Traces.*

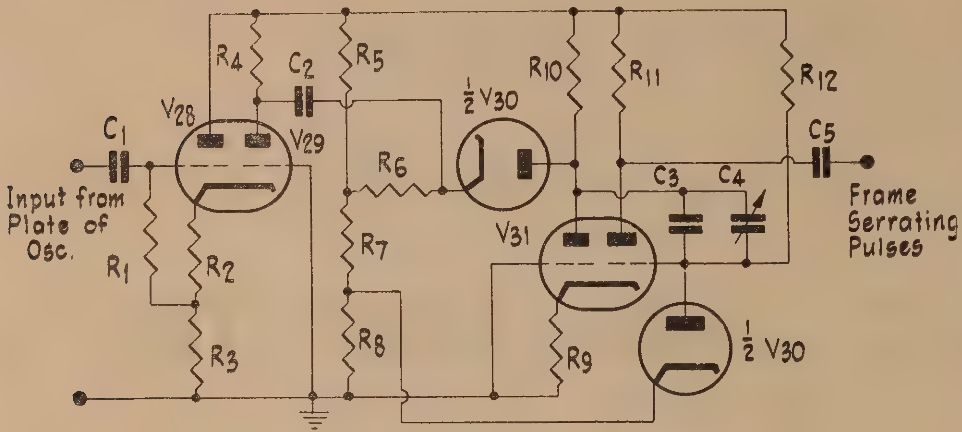
How to Use Signal Generators, by J. R. Johnson is the first book to devote itself entirely to all types of signal generators. The book gives various test uses for A.M. signal generators, F.M. signal generators, test oscillators, marker generators, sweep generators, and calibrators. It discusses the problems involved in using this equipment and how to overcome them. Typical test set-ups are given for use in A.M., F.M. radio and TV servicing. The technician learns how to adapt signal generators to various applications and so increase their usefulness to him.

The second book, *How to Use Meters,* by John F. Rider, is written for the service technician, the TV and radio student and the ham, and discusses all types of meters and how to use them for servicing TV and radio receivers, audio amplifiers, power supplies and amateur transmitters.

The panel type meter, volt-ohm-milliammeter, vacuum tube voltmeter, etc., are discussed from the viewpoint of their practical applications to servicing.

Obtaining and Interpreting Test Scope Traces, by John F. Rider, gives the service technician more than 500 actual test scope patterns and explains what they mean. It discusses how to obtain maximum value from the scope when servicing TV receivers, F.M. and A.M. radio receivers, audio systems and test equipment. Specific test equipment set-ups are shown with each application.

The "R. & E." Synch. Signal Generator—Part VII



C_1, 50 $\mu\mu$f.
C_2, C_5, 0.005 μf.
C_3, 25 μf.
C_4, 3–30 Philips trimmer.
R_1, R_9, 5k.
R_2, 1k.
R_3, R_8, 2k.
R_4, 15k.
R_5, 10k.
R_6, R_{10}, 100k.
R_7, 30k.
R_{11}, 5k.
R_{12}, 3 meg.
V_{28}, ECC91 or 6J6.
V_{30}, 6AL5 or EB91
V_{31}, ECC91 or 6J6

Part VI of this series, presented in the July issue of *Radio and Electronics,* gave the circuit of the two frame pulses, which are triggered at the same time, but which have different durations. The frame blanking pulse is the longer, and lasts for from 14 to 14½ lines, while the frame keying pulse lasts for from 4 to 4½ lines in duration. In the diagram, both were labelled as B at their output terminals, but the lower one should have been called B′, to distinguish it. The upper chain is that for the frame blanking signal, while the lower is the frame keying signal. The nomenclature does not matter very much, for, apart from the timing condensers C_4 and C_8, the circuits are identical, even to the component values. If those following this series will label the lower output B′, it will make reference to the circuit easier later on.

The only basic waveform that remains to be made before we start combining them in mixing circuits, is the one variously known as the frame synchronizing signal, or the frame serrating pulses. The former description is a little misleading, since one expects any waveform with the label "frame" attached to it to have a frequency of 50 c/sec., whereas the waveform concerned is actually at a repetition frequency of twice line frequency, or 20,250 c/sec. These are the pulses which are allowed to take place for a period of four lines, once in every frame, so that in practice, eight of these pulses occur during each frame. In the mixer circuit, the frame keying pulse, whose position in time corresponds with the desired position for the serrating pulses, and in duration lasts for four lines, allows eight frame serrating pulses to appear, in a "hole" provided for them by using the same keying pulse to remove four of the line synchronizing pulses.

Since the frame serrating pulses have the same repetition frequency as the master oscillator, the circuit which makes them must clearly be excited from the oscillator circuit. Now it will be remembered that the line synchronizing pulses are made in such a way that their leading edges are triggered by, and coincide with, every second negative-going jump at the plate of V_2. The circuit generating the twice-line-frequency pulses is of the same general kind as the line pulse generator, and indeed of the rest of the pulse generators in this circuit, so that its triggered edge is positive-going. Moreover, half of its triggered positive-going edges coincide with line synch. pulses, and so are able to trigger the line time-base of the receiver in lieu of the line pulses during the four-line period of absence of the line pulses. Because of this we must see to it that the generator of the frame serrating pulses is triggered by the same negative voltage jump as triggers the line pulses, and the best way of doing this is to feed the circuit from the same point as the line circuits are triggered from. It is desirable, too, to have a buffer stage between the oscillator and the pulse generator, just as is done in the frequency dividers, but if we interpose a buffer of the conventional kind, we will find that the voltage jump which we must use to trigger the pulse generator is now positive in polarity, whereas we want a negative pulse to trigger the generator from. This difficulty is resolved by making use of a property of the cathode-coupled twin-triode amplifier, which does not invert the polarity of any signal fed to it. We therefore use this as the buffer stage, and obtain our negative-going trigger voltage, occurring at the correct time. Reference to the circuit will show that apart from this change, and of course, except for the time-constant of the grid of V_{31}, the circuit is identical with those of the other pulse generators and frequency dividers. In this case, a portion of the condenser determining the time-constant has been made variable, to form a control for the width of the frame serrating pulses.

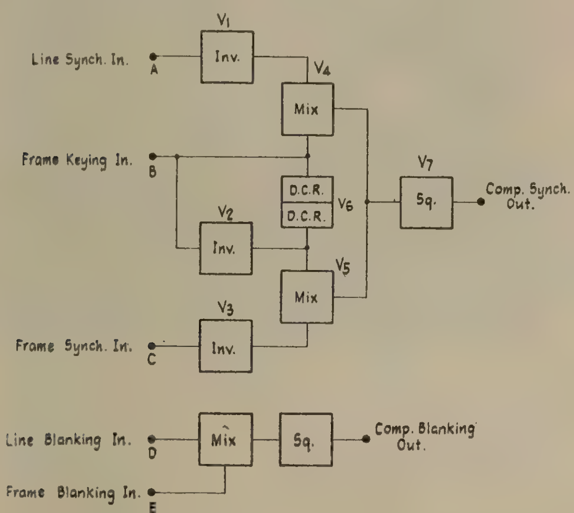
Incidentally, these pulses form an excellent illustration of the confusion which sometimes arises in the nomenclature of such things. It would be possible to call them either narrow negative-going pulses, or wide positive-going pulses. This possibility always occurs except where the positive and negative half-cycles are of equal duration, but we prefer to call them wide positive-going pulses, since the positive edge is the one which is positively initiated by the circuit action—triggered—in other words. This seems the natural name to give them when the effect is tried of varying the size of the timing condenser, for the positive-going edge stays put, as it were, while the position of the negative-going trailing edge varies in sympathy with the control.

PULSE MIXING CIRCUITS

Here we meet some fresh circuits for the first time for several instalments. This lack of variety, however, is quite intentional, proving as it does the actual simplicity of an apparently complicated circuit.

The term "mixing" is perhaps not the best one to use. "Combining circuits might be a better one since the arrangements have little in common with what are usually called mixers. Better still would be to call them keying and combining circuits, because there are really two distinct and separate functions which can be lumped together under the heading of "mixers." A schematic of the circuits is given in the block diagram of Fig. 11.

The functions of the various blocks are indicated on the diagram, but some explanation might be helpful. Each tube labelled as a mixer is an EF91, with one signal applied to the control grid and another to the suppressor. The blocks labelled "Inv.", which is short for Inverter, are simple amplifiers, whose functions is to invert the polarity of the pulses. Whether or not an inverted pulse precedes the appropriate input



terminal of each mixer depends only on the polarity of pulse required by the mixer, compared with the polarity of the signal as it appears in the timing unit, already described. The upper mixer tube, V_4, requires negative-going line synch. pulses, but the output polarity from the line synch. pulse generator is positive, and so an inverter is used at this point. The frame keying signal comes out of the timing unit as a negative-going pulse, and is concerned in two mixing operations—first, the keying out of line pulses for its own duration, and secondly, the keying *in* of the frame serrating pulses (or frame synch. pulses) for the same period of time. For purposes of keying a signal in, the keying pulse must be applied positively to the suppressor of the mixer valve, so that while it is there, the valve is allowed to amplify the pulses that are to be keyed. For keying out, the keying pulse must be in negative polarity at the suppressor, so that while it is there, none of the controlled pulses are allowed to be passed by the valve.

V_6 is an EB91, or 6AL5, with the halves used independently as D.C. restorers, at the suppressors of the two mixer valves. Their purpose is to ensure that the keying waveforms do not drive the suppressors appreciably positive, and that the whole keying waveform extends negatively from earth potential, thus cutting off the tube during the negative half-cycle.

The mixers, V_4 and V_6, together form a third mixer, by virtue of the fact that they have a common plate load resistor. Their output waveforms are thus added together in this resistor, the combined result being the composite synchronizing signal. V_7 is a squarer, whose duty is simply to remove any imperfections in the mixed waveform, and give it the nice square tops and bottoms that we like to see on all pulse waveforms.

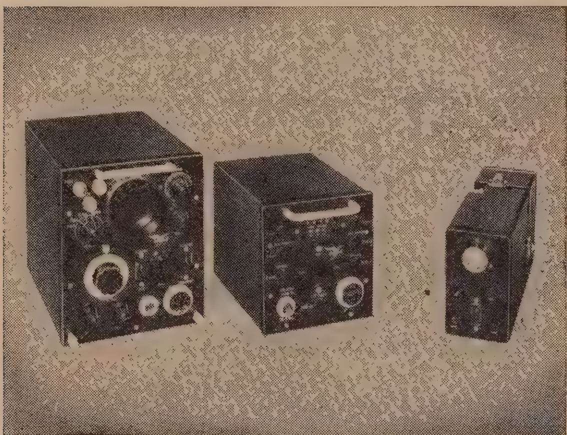
Not connected with the synch. signal mixer at all, but on the same chassis with it, is another simple mixer for combining the line and frame blanking signals. This mixer, too, is followed by a squaring stage.

(To be continued.)

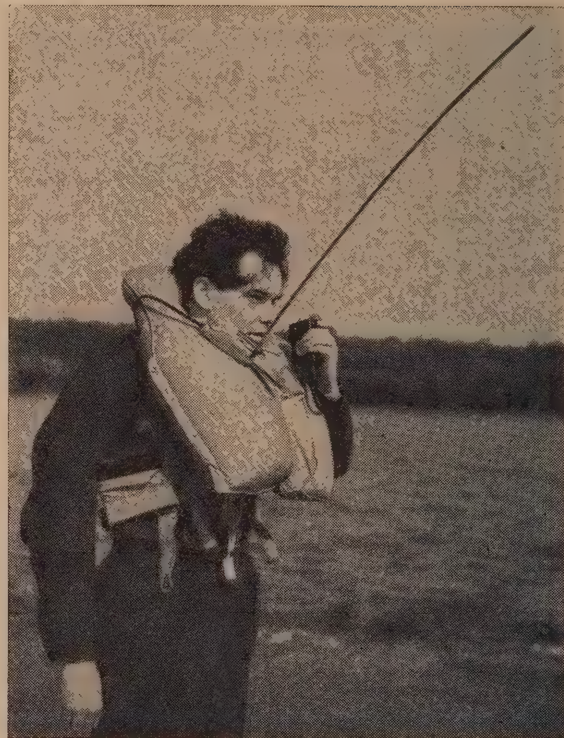
LIFESAVER SARAH

SARAH—short for Search And Rescue And Homing—is a new British invention which will revolutionize air-sea and land rescue operations. With it, air-crash survivors, shipwrecked seamen and stranded personnel in jungles, mountain country, and in desert can be located by day or night and in any sort of weather. One high-flying aircraft can now search the same area as ten low-flying aircraft using older methods. The R.A.F. have adopted SARAH, which will be the standard rescue equipment by the end of 1954.

SARAH is a radio beacon weighing only 20 ounces and measuring seven inches by one inch square.. This together with a 32-ounce battery is attached to the survivor's Mae West or flying suit. All the stranded man has to do is to pull a small ring which releases a 31-inch flexible aerial and starts the beacon transmitting the signal that will guide the searching ship or aircraft.



Lifesaver SARAH—the Rescue Receiving units carried by searching aircraft, helicopters, and surface vessels. Left, the receiver; centre, the power pack; and right, prototype of a new miniature combined power unit and receiver.



The survivor's equipment—the 20-ounce transmitter in the pouch of the right shoulder of the inflated Mae West, with the 31-inch aerial in the unfurled position. In the left hand the two-way speech unit, and under the right armpit the 32-ounce battery which enables the transmitter to send out "homing" signals for 20 hours.

In the searching craft the signals are picked up by twin antenna and displayed on a cathode ray tube. When the rescue craft is heading straight for the transmitting beacon the signal from each antenna will be displayed as "spikes" of equal length on either side of a central trace. The rescue craft thus "homes" on to the stranded man or alternatively, by steering another course obtains a second bearing and hence a "fix."

As the searching aircraft passes over the beacon the signal trace will disappear. Smoke signals or flares are then dropped and the position radioed to helicopters or ships, to complete the rescue.

The tiny transmitter will signal continuously for 20 hours with a maximum range of 66 miles to an aircraft at 10,000 feet. A distress signal at sea can thus be picked up by an aircraft within an area of 10,000 square miles. Satisfactory signals—at smaller ranges—can be received by aircraft up to 60,000 feet. Surface ships fitted with the 24 lb. SARAH receiving apparatus will pick up the beacon's signals at a range of six miles.

A special coding device incorporated in the transmitter produces pulse variations that enable the operator in the searching craft to identify any number of beacons in the same area.

A 12-ounce, two-way speech unit can also be incorporated in the stranded man's transmission unit to provide short-range verbal communication to assist the final stages of the rescue. Although stranded personnel can thus talk to the rescuing craft, they cannot waste their batteries by talking to one another as speech units are not "compatible."

Research on SARAH, which was designed and produced by Ultra Electric Limited, Western Avenue, London, W.3, has been going on for five years. Tests have been carried out in specially heated steam rooms at 158 degrees Fahrenheit and the transmitter has been embedded in ice at 58 degrees of frost. SARAH is waterproof and in its present form will withstand water pressure to a depth of 50 feet.

More than 200 delegates of the North Atlantic Treaty Organization and the European Defence Community were recently invited to see SARAH at the Royal Aircraft Establishment at Farnborough. The equipment has

(Concluded on Page 48.)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SHOES and SHIPS

"The time has come," the Walrus said, "To talk of many things. . . . "

By Special Arrangement with the Walrus

The Long Arm of Coincidence

The modern radio serviceman, contrary to what he might be told, knows that gremlins, witchcraft, and black magic do exist—and grey hairs follow in their wake! Gremlins were largely occupied during the last world war pulling the airstrip away from underneath aircraft about to land and suchlike hair-raising tricks. They have, however, found new fertile ground in cussed radio sets that will go wrong when they shouldn't. Witchcraft of a radio variety is then frequently practised to find out the why and wherefore of such complaints and the black magic section is vitally necessary in order to try and keep numbers of antediluvian sets (always treasured by their owners) operating. Unlike wine they don't improve with keeping.

Recently the Walrus was called upon to service a set for a friend. The set had various complaints, most of which were easily rectified.

The usual odd valve for replacement and a slipping dial cord along with a faulty wave-change switch.

The dial cord complaint is a common fault and one fairly well known amongst servicemen—continual tension had stretched the cord so that the take-up spring is slack but has sufficient pull to turn the dial when the set is cold. When it has been operating in a cabinet for a time, however, the temperature of the set rises due to heat dissipation from the valves and power transformer until the cord expands and loosens up, allowing the tuning spindle to slip.

The wave-change switch was a different problem though, the passage of the years had blackened the plating on the contacts and an accumulation of dirt had left it in pretty poor condition. As it was a bandspread job with five bands, to replace the switch was a major operation which would have cost plenty, so it was cleaned up with a cleaning fluid and lubricated which improved matters quite a bit.

This was followed by a check of the alignment and I.F. sensitivity, all of which seemed satisfactory—it was noticed that the sensitivity at the high frequency end of the scale was dropping off but not badly so—this sort of fault is common in sets getting on in years due mainly to dust penetration and film forming on coils, valve sockets, wave-change switch, etc. When the owner came to collect his set he inquired whether an extension speaker could be fitted. The answer was, "Yes; let's have the speaker." The speaker was produced next day (he had only brought the chassis in for service) and only one finger had gone through the cone which wasn't bad considering all things. Incidentally, this was repaired with cellophane tape which makes a better job of cone repair than most forms of glue.

The extension speaker was arranged to be taken off the voice coil winding of the output transformer by means of a switch which selected either the set speaker or the extension and this was mounted on a little bracket to be screwed onto the cabinet in a handy position at the rear. Once more client departs—next day comes phone call—every time a light is switched on the set goes "plop", is that alright because it didn't do it before. Knowing the customer very well, the Walrus suggests candles for lack of any other bright thoughts on the subject and forgets about it. The following day comes another S.O.S., the refrigerator door was opened and the set blew up—why do sets always blow up. Now what that particular refrigerator door had to do with the set was more than I could guess, so the set had to come in again. It took only a minute to find the trouble, the output transformer had opened up in the primary winding. No doubt the weakness was there and it was due to go and the momentary shock incurred on change-over from one speaker to another had hastened its downfall. The refrigerator door was probably quite blameless although the shock in the electrical circuit of the little interior lamp coming on might have had some bearing on it. However, it's a good thing the coalman wasn't emptying a sack of coal in the bunker at the crucial moment—he might have been the victim instead of the refrig. door.

Anyway the customer received the full explanation along with a few facetious remarks about don't open the door again but cut a hole in the side—all of which he accepted with broad smiles. Fortunately he was that type of customer!

Missing and Stolen Radios

Criminal Investigation Branch, Rotorua:

Regent 5-valve, battery/electric portable, serial No. 21626—bright red cabinet.

Criminal Investigation Branch, Christchurch:

H.M.V. 4-valve broadcast model battery portable; black bakelite cabinet, 9 in. x 3 in. x 1½ in., handle on top; lid raised by end pressure to show tuning dial. Serial number of four figures with letter "C" in white paint on chassis.

Philips 4-valve broadcast model battery portable—similar to above.

Philips A.C./D.C. portable model 545, serial No. 203; tan coloured case; carrying handle on top; new batteries.

Criminal Investigation Branch, Auckland:

New World model, serial No. 503; brown wooden cabinet 18 in. x 12 in. x 12 in., sliding dial.

Upper Hutt Police Station:

Philips 5-valve, battery/electric portable, Model 427, serial No. 26606, royalty No. 50618; brown cabinet.

Central Police Station, Wellington:

Ford auto radio, serial No. 6116 and speaker; colour brown.

D. A. Morrison & Co., Wanganui:

Tuning unit of Ultimate 12-volt auto radio, serial No. 149393,

No. 9

LABORATORY NOTES
from
BEACON RADIO LIMITED

CORROSION IN OUTPUT TRANSFORMERS

The problem of electrolytic corrosion in coils wound with fine gauge wires is an old one. It appears that electrolytic corrosion is caused by minute D.C. currents flowing through an electrolyte formed in the insulation of the coil and ionizing the copper of the wire. The current may be caused by a potential difference due to a voltage applied to the coil or to a galvanic action at the junction of dissimilar metals.

Moisture condensing in the coil, chemical changes in the insulating material or the presence of fungus may cause an electrolyte to form. Transformers standing idle are more likely to absorb moisture than those in use.

It is possible to offer almost complete protection to a coil by using inert insulating materials and hermetically sealing the finished transformer in a suitable can. This is an expensive process and uneconomical for ordinary uses such as output transformers in mass produced radio sets. Protection is offered by the following processes; vacuum impregnation and dipping, vacuum impregnation, varnishing. The degree of protection falls off in the order shown.

The principle of isocoring has proved very effective in practice for minimizing breakdown in D.C. circuits. Careful selection of impregnation materials and proper impregnation techniques such as used by Beacon plays a big part in preventing premature transformer breakdown.

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Sound Reproduction—Science or Art?

By V. M. Stagpoole

Audio enthusiasts over the years have been puzzled, and occasionally hurt, by the philistine attitude of the general public towards their attempts to reproduce music so that it sounds like the original.

In the past it has been known that the reproducing equipment was by no means perfect and efforts have been made to improve it, but with little success. Tests show, for instance, that the ear is capable of hearing about 0.5 per cent. harmonic distortion and the answer has been to reduce this distortion to even lower levels. But still the ear can distinguish the difference between live and reproduced sound. Equipment which by the finest tests available is proved as near perfect as the state of the art permits, does something to sound that enables the ear to detect its use. This either means that the ear, and by that we mean the whole mechanism between the ear drum and the "consciousness, "is capable of detecting lower distortion levels than our best instruments, or that we are on the wrong track altogether and the distortion content of the material is not critical below a certain level.

The failure to produce real "high fidelity" is, curiously enough, not entirely the radio engineer's fault. A large portion of the blame can be placed upon the neurophysiologists who, until quite recently, were unable to present any consistent theory to account for the action of the brain. As long as this state of affairs exists, then the audio experimenter is completely in the dark. Sound reproduction cannot, under these circumstances, be called a science, and, since it concerns our aesthetic sensibilities and is largely a matter of trial and error, must be classified as an "art."

During the past decade much work has been done on giant calculating machines of the electronic type. Who has not read sensational accounts of these great machines "thinking?" This is not such a fantastic conception as it seems because any problem which is capable of reduction to symbols can be answered by a machine designed to use those symbols. This work in the field of cybernetics has led to similar work in the application of calculator theory to the functioning of the human brain.

This fruitful line of research has given us a considerable insight into the actual physical make-up of the brain and may enable us to see where errors have arisen in attempts to reproduce sound. We cannot here go further into the similarities between the brain and electronic calculators, but those interested are referred to "Physiological Feedbacks," by T. E. Ivall, April 1952, *Wireless World*.

Audio engineers have asked "can the ear detect distortion?" The question should have been "does the ear detect distortion?" In this difference lies the crux of the problem. We are not concerned with what the ear *can* do, but what it actually *does*.

THE HUMAN CALCULATING MACHINE

Only now is it beginning to be realized that the human brain is not a haywire accident of nature but an efficient and accurate calculator many times more complicated and quicker than the best electronic brain.

It is believed that a perfectly functioning human brain is capable of solving all problems of certain types, provided it is given the correct data. What kind of problems? Mainly those concerned with survival, although we know of phenomenal people who can perform mentally, immense mathematical calculations. Primitive man, walking through a forest, meets a sabre tooth tiger. His brain is presented with a problem—how to survive? It calculates with all the available data. The pros—strength of the man, his weapons, his agility, etc. The cons—size of the tiger, length of its teeth, its hunger, etc. In a split second it arrives at the answer, which almost certainly would be "run away." If this calculator made a mistake it might answer "walk towards the tiger" with fatal results. Now this calculator has been turning out answers for about a million years, so it follows that if it ever got wrong answers because of an inherent constructional fault in the brain the human race would long since have been wiped out. The human brain, provided it hasn't been physically or psychologically damaged, solves perfectly the question of survival.

THE BRAIN AS A LISTENER

It is fairly well established that in direct comparisons the ear can tell the difference between "canned" and "live" music, but in attempting to fool the ear we have unconsciously assumed that the ear detects the difference by the distortions added in conveying the sound from the microphone to the speaker. From 5 per cent. distortion we have dropped to 0.1 per cent. distortion. From 100–5,000 cycles we have raised the range to from 40–2,000 cycles, and still our ears tell us the difference. Its a bit more difficult but they usually tell us the right answer.

Let us apply our new theory of brain operation to listening and see if we can arrive at a logical answer to our problem. When we listen to music our purpose is, presumably, for pleasure and our brain calculates with that object in mind. Hum, scratch, harmonic distortion, having nothing to do with the problem are spurious data which the brain rejects from its calculation (in the same way that a penny stamp machine rejects half-pennies) *unless* it is called on to listen for them. Everyone has experienced this effect, sometimes known as the "ear's A.V.C." People working in extremely noisy surroundings can talk to each other comfortably when a visitor is completely deafened. Aircraft pilots can communicate by radio through noise and distortion which completely baffles the casual listener, and, perhaps the most common experience of the radioman, the people who listen to the radio programmes through the 100-cycle hum caused by dead filter condensers. In the latter case this, to the acute ear, intolerable noise, is often unheard by the owner unless his attention is deliberately drawn to it.

It was pointed out to me the other day that when the victim finally gets round to complaining to a serviceman, he frequently calls this trouble a "buzz." In other words his ear has tuned out the 100-cycle fundamental as it gradually appears over an extended period, and until the higher harmonics are bad enough to completely break up the programme he is still satisfied.

I hope this will be enough to make my point. The ear does not identify the difference between real and reproduced sound by what is added, unless called on by command to do so. Obviously there is only one thing left, the difference is detected by deletions from the original.

This ties in with our calculator theory. If our machine adds information to the problem data it will get the

wrong answer. A machine which arbitrarily multiplied all its answers by, say, 7.32 would soon go on the scrap heap, or, returning to our story of primitive man, if his brain had suddenly told him there was another tiger behind him he would probably have stood still and his life expectancy would again be considerably shortened.

Returning again to the art of listening. We can see that the brain as a successful calculator must not add information to that received from the ears except in one way, as a comparison with data from its memory. Now, very few people have good musical memories so the only way to judge reproduction is to attend all possible live performances and when the memory is still "fresh" as it were, make an immediate comparison with the sound system under test.

What are these things that are missing from reproduced sound? There are two of them which appear to be important. Transients and bass. The question is sometimes asked "why does the brain not tell us that these things are missing directly, instead of merely telling us something is wrong?" Once again, this is a matter of the design of the calculator. The brain is designed to produce a result, not the intermediate details. It would be exceedingly tedious if instead of giving the pleasure of listening to music, it presented us with a running commentary on the precentage of distortion, the lack of transients or the exact frequency at which the low notes disappeared.

In a previous article ("The Transient Response of Audio Systems," July, 1953, *Radio and Electronics*) transient response was discussed, and it was pointed out that most transients are lost at the microphone, unless some form of microphone with an extremely high diaphragm resonance is used.

The condenser microphone, the only one which is satisfactory in this manner, was the subject of two articles in the February and March 1953 *Wireless World*. The particular microphones discussed are similar to those used by a prominent English recording company whose wide range recording is well known. It is also interesting to note that Briggs in the latest edition of "Sound Reproduction" quotes the condenser microphone for the highest quality of sound recording—a fact that is becoming increasingly well known to recording engineers.

In tests conducted by Mr. H. J. Leak in connection with the famous "Point One" amplifier, a condenser microphone was used, indicating that he realizes that the standard of the amplifier is quite unimportant unless a good sound transducer is used.

There is little that the sound enthusiast can do about transients, apart from the use of a good pick-up and loudspeaker. Transient response has been determined for him by the source of progamme, but when it comes to bass response then in a large measure he is his own master. Once again it is a matter of comparison, no one can truly judge the technical quality of a programme on a 5 in. speaker (not that some don't try!). One can only get a satisfactory idea by comparing the results with a live source of a similar type. Many of us have put up with inferior bass response for so long that we are quite amazed when we hear a band with some "body" to it. We walk past the juke box in the milk-bar,

(Concluded on Page 48.)

MICROGROOVE RECORDS—Are We Too Fussy? Or Not Fussy Enough?

Now that long-playing records have really arrived, and look as though they are here to stay, an appraisal of their advantages and disadvantages seems to be in order, especially as quite a large number of record enthusiasts appear to have an exaggerated idea of what can be expected from them. In other words, *are* microgroove records the answer to the gramophone enthusiast's prayer, or are they not? If they are not, in what respect do they fall short of ideal requirements? To what extent, if any, should the manufacturers be blamed when the purchaser takes a record home and is disappointed in it? Is the user to blame at all, or the retailer from whom he makes his purchase? These are some of the questions to which enthusiasts want answers, and we may as well say at the outset, that practically all of them are capable of being answered unequivocally with a straightforward "Yes" or "No."

PERFORMANCE OF L/P RECORDS

As most of our readers will have guessed, this article is prompted by the fact that one often hears microgroove records roundly condemned by disappointed buyers—either that, or else the makers are taken to task in no uncertain manner, and various suggestions are put forward as to what the manufacturers, or their agents here, should do so that the users' demands shall be satisfied. Indeed, while sympathizing with those who put down their hard cash and then suffer a disappointment which cannot be allayed, even in part by returning the record and getting their money refunded, it does seem to us that some of these people are expecting too much from microgroove records. Let us explain why we take this view.

As a starting point we can take one undoubted fact, namely that the best microgroove records provide a quality of reproduction which leaves far behind that of even the best 78 r.p.m. ones. There will be few who cavil at this statement, sweeping though it may be. The next point is that not all microgroove records attain this high standard. Not even the makers themselves would dispute this, even though they may admit it with regret, so that the question arises, "Are those why buy L/P records entitled to expect all of them to reach the same high standard as the best undoubtedly attain?" And this is where we come to ground that is not quite so secure, for the answer one gives can expect to be coloured by one's own opinion, which in turn will be conditioned by a number of facts which are not necessarily relevant, such as whether one has been lucky or unfortunate in the records he has bought so far, and whether or not he has playing equipment of the highest possible standard. At any rate, it is always illuminating to look at a problem from the other man's point of view, so before pronouncing judgment, let us look at the matter from the maker's angle.

Here is a new product—one which at its best represents by far the highest quality in the electromechanical reproduction of sound from discs. From the manufacturer's point of view, however, it is a very much mixed blessing. In the first place, the manufacturing techniques are very, very much more difficult than those associated with the production of 78s. A full discussion on the technical aspects of the problem is not quite applicable here, but some examples will show readers what the makers of L/P records have to contend with. In the first place, the almost non-existent surface noise of L/P records is entirely due to the material of which the pressings are made, namely vinylite. The 78 r.p.m. record is made from a composite material of which the basis is shellac. Now this material is very hard, once it has left the heat and pressure of the press in which it is made, and has a granular structure if viewed under the microscope. It is this which accounts for the major portion of the surface noise of these records. L/P record material, on the other hand, is mechanicaly homogeneous, so that no minute irregularities exist in the material itself, which can cause the sudden small deflections of the playing stylus point which we identify as noise. Unfortunately, however, the L/P material, by comparison with shellac, is very soft, and thus is much more subject to damage, both during and after manufacture of the record. Such damage, it should be understood, can and does occur at any time, and unless it is exceedingly bad, is completely invisible. This brings us to the question of the inspection of finished records at the factory, before they are passed for sale. Here, the maker is at a very grave disadvantage with L/P records. With 78s, it is true to say that 95 per cent. of mechanical faults, such as could cause continuously high noise level, or intermittent noises, can be observed under a magnifying glass by a trained operative. With 78s, some of them, once found, can even be removed by judicious "doctoring", so that an otherwise perfect disc no longer needs to be rejected, and in such cases, the user would have no knowledge that any handwork had been done. With microgroove recordings, however, the situation is completely reversed. Minute faults, such as produce a small isolated popping noise, cannot be detected at all except by playing the record, and this is where the rub comes in! The very feature of L/P records that commends them so greatly to music lovers is a source of considerable difficulty to their makers. In other words, it takes so long to play through an L/P record that it is quite impracticable for the manufacturer to perform what he calls "music testing" on each one; that is to say, to play each record through completely in order to accept or reject it. What does this mean both to the maker and to the user? With 78s, the operatives manipulating the record presses, and the specially trained inspectors who examine each disc for defects can tell very readily whether the stamper is either damaged or worn, simply by looking at it. For L/Ps, they have no such simple test, for the very good reason that a suitable test does not exist. All that can be done is to music test a certain number of records, as a batch is produced, by playing several portions in different places on the disc, for brief periods.

At this point, the disappointed buyer might say, "Well, they ought to test each record in its entirety before asking me to part with my money," but has he

stopped to consider what would be the effect on him if the record companies suddenly laid down the policy that this must be done? It would simply mean that L/P records would cost about ten times their present price, unless the makers were to turn philanthropists and lose money on every record sold. The price the consumer has to pay for any repetitively produced article is almost in direct proportion to the rate at which the processes of production can be kept going. And here, incidentally, is a nice quick way for anyone with an inventive turn of mind to make a fortune. All he has to do is to invent a method whereby L/P records can, in a matter of seconds, be guaranteed against defects which will show up when they are played!

At this point, we can hear rumblings to the effect that we are doing nothing but make excuses on behalf of the record manufacturers, but such is far from being the case, as we hope to show soon. Another point which makes the whole thing a difficult one is that the nearer any process comes to perfection, the more glaring do any residual defects become. Where is the audio enthusiast who has not made a substantial improvement in one part of his equipment, only to find that the whole sounds very much worse than before, because a defect which was previously masked by another, different one, is now displayed in its true and horrible colours?

In other words, minute defects, such as a small "pop," which on a 78 record would go quite unnoticed amid the general noise level, now stick out like the proverbial sore thumb when transferred to an L/P record which has almost no surface noise. To make a loud complaint about the small "pop" on the L/P record is to do nothing more than say that L/Ps are not perfect. But no one in his senses would claim that they are, least of all, as we have said, the makers themselves. They know that such things occur, and are no doubt spending much time and money in trying to find a remedy, in the shape of a suitable recording material which is not so easily damaged as vinylite, which though workable, is far from ideal as a pressing material. The purist who complains about the slightest imperfection on an L/P record is obviously expecting a good deal more than he is entitled to. He is also inconsistent, because he says in effect, "I want to buy L/P records, because of the advantages which they undoubtedly confer, but at the same time I'm not prepared to buy one that is not perfect." He didn't make this sort of moan before the days of L/P records. He accepted the fact that some records are better than others, and saw to it, as far as possible, that he did not buy the poorer examples of the recordist's art. Why, then, should he change his attitude now?

SELECTION OF L/P RECORDS

Unfortunately, there is one thing about the sale of these records which gives some semblance of justice to complaints about imperfect discs—but only a semblance. It is that retailers will not allow any L/P record to be played, for approval or otherwise, by the prospective purchaser. This does create a difficulty, or rather a number of them, to which there do not appear to be satisfactory answers as yet. Before we discuss the question, it should be pointed out that this is not peculiar to New Zealand. The same thing obtains elsewhere, and is attributable both to the fragile nature of L/P records, and to the demands of record enthusiasts that any record they buy must be unplayed. This is something which we think they have every right to demand, and in view of the easily damaged nature of these records, it would be unreasonable for anyone to insist that they hear a sample of the record before they decide to buy. At the same time, it does make the buying of L/P records, musically, something of a pig-in-a-poke. There are two sides to every recording, in more senses than one! So far we have been discussing its technical quality alone, but there is also its musical quality. It is small recompense to a buyer if when he gets a record home, he finds it technically excellent, but does not like the musical interpretation. This, like the mechanical quality, can only be judged by hearing the record, so a stalemate would seem to be reached. The only solution is to hear the recording over the air first, in order to judge its musical quality, and then to hope for the best otherwise. This is admittedly far from a perfect answer, but it at least prevents the purchaser from being saddled with a rendering of his favourite concerto, of which he does not approve. If he **must** buy the latest recording of a certain work, without having heard the rendering before, then it is hardly consistent of him to complain that it does not come up to expectations! Nor let him bemoan the fact that trial playings are not allowed in the record shop, particularly if he is the kind of buyer who himself insists on being given unplayed discs. He should remember that at least half the situation is due to his own demands in this respect!

CARE OF L/P RECORDS

In earlier paragraphs, we have said several times that microgroove records are fragile and easily damaged, even though they are justifiably advertised as

unbreakable! Many users, we are convinced, do not realize just how delicate they are. When we said that the material is soft, we meant just that. A thumbnail, carelessly run across the grooves can cause a scratch that will produce a click every time the pick-up comes to it. There is one golden rule in the handling of them, and that is "Dust is anathema." Dust, moreover, with a capital D, because directly and indirectly, it is the cause of most of the avoidable damage that occurs, and which impels careless users to condemn the records in some such terms as "They don't last five minutes." Dust, for the most part, consists of minute particles which have just the wrong characteristics to go with vinylite pressings. Much of it is extremely hard and abrasive, with the result that should a particle of it get into the record groove, the stylus presses it into the soft material, causing some of it to be gouged out; the next time the record is played, this defect is heard as a noise, while the stylus uses the particle of dust once more as a spade, to dig still more out of the delicate surface.

Then there is the practice of handling records with the fingers touching the playing surface. This in itself need not cause damage, but it does deposit a film of moisture or oil on the surface of the record, which enables dust particles to adhere to it more readily. Similarly, the practice of placing records one on top of the other, out of their protective covers, is a very bad one since dust particles become trapped in the grooves, and cause scratches as soon as one disc is moved with respect to the other. All this boils down to the following simple rules for handling L/P records:—

(1) NEVER allow a record out of its dust-cover except while being played.

(2) Be careful to exclude all dust from inside the playing compartment of the radio-gram.

(3) Never touch the grooves with the fingers.

(4) Never stack un-covered records (see (1) above).

(5) DO NOT attempt to clean dust off L/Ps with a dry cloth.

These are the most important "don'ts", apart from the obvious ones of not playing them with (a) an acoustic sound-box or (b) the wrong pick-up head, i.e., the one with the stylus suitable only for 78 records.

There are others, of course, such as storing them only vertically, but with the opening in the envelope at one side, to prevent the ingress of dust, and taking precautions when carrying them where dust is prevalent, as in a car, in which case the pile of records should be wrapped in paper to exclude the dust.

CLEANING L/Ps

With so much talk of cleanliness, we could justifiably be taken to task were we to omit to mention proper cleaning methods. Unfortunately, using a cloth as a duster is quite the wrong answer, for this by electrifying the surface, causes it to attract more dust. The reason for the latter will be appreciated when you remember your earliest school experiments in electricity. They had to do with "static" electricity, as can be made by rubbing the surface of a good insulator with a piece of dry fur or silk. Do you remember how the glass or ebonite rod became electrified, and was able to attract even small pieces of paper? Try it now with your ebonite fountain pen, and notice how much dust it will attract to itself. The answer to this is that the only satisfactory way of cleaning records (and this applies to both L/P and 78) is to wash them in tepid water containing a small amount of detergent, in cases where they are very dirty, and for routine wiping before playing, to wipe them gently with a cloth which is damped with the same material. Alternatively, the special materials sold in small bottles especially for the purpose, can be used.

CONCLUSION

The conclusions to be drawn from the above are as follows:—

(1) While L/P records represent a great advance over 78s, they are not yet perfect, and the purchaser must either accept this as a fact, or else refrain from buying them. Which he does is up to him. The makers are doing everything possible both to effect improvements, and to ensure that as far as is at all possible, he gets a brand new pressing, unplayed, and as free from unavoidable defects as possible, though at the present state of the art, such defects certainly do exist.

(2) In order to get the best out of L/P records, the user must exercise much greater care than has been his custom with his more robust 78 r.p.m. records.

(3) In ensuring that the buyer gets an unplayed disc, the sellers make it difficult for him to hear what he is getting, and at the moment, this is something with which he must put up.

From the user's point of view, the vexed question of demonstration playings is certainly a hardship, but this does not mean that the same situation will always

(Concluded on Page 48.)

The PHILIPS Experimenter

An advertisement of Philips Electrical Industries of N.Z., Ltd.

No 71: Philips Germanium Diodes and their Application—Part II

Reprints of these EXPERIMENTER articles, complete with illustrations, will be mailed to any address for one year for a subscription of 5s. Application should be made to Technical Publications Department, Philips Electrical Industries of New Zealand Ltd., P.O. Box 2097, Wellington.

In last month's Experimenter we described germanium diodes in general terms, showing how they differ from thermionic diodes. Their characteristics and ratings were also discussed, so that we are now in a position to list these factors, as they apply to the Philips range of germanium diodes.

TABLE I—CHARACTERISTICS

	OA50	OA51	OA52	OA55	OA56	OA60
Turn-over voltage	75 v.	75 v.	90 v.	120 v.	85 v.	30 v
Minimum forward current at +1 volt	5 ma.	5 ma.	4 ma.	3 ma.	4 ma.	—
Maximum reverse current (at — volts)	50 μA. at —10v.	10 μA. at —10v.	50 μA. at —10v.	6 μA. at —3v.	50 μA. at —10 v.	—

TABLE 2—RATINGS

	OA50	OA51	OA52	OA55	OA56	OA60
Continuous reverse working voltage (max.)	60 v.	35 v.	80 v.	100 v.	70 v.	25 v.
Max. average D.C. forward current	40 ma.	40 ma.	40 ma.	40 ma.	50 ma.	—
Max. recurrent peak forward current	150 ma.	150 ma.	150 ma.	150 ma.	150 ma.	—
Maximum forward surge current ..	500 ma.	500 ma.	500 ma.	500 ma.	400 ma.	—
Equivalent American type	IN34	IN54	IN57	IN38	IN48	IN60

NOTE ON TYPE OA60

This diode is designed as a video detector, and its characteristics are specified only by the results of the following test. The detection efficiency (i.e., peak output voltage/peak carrier input voltage) shall not be less than 0.6 (60 per cent.) when it is used at a carrier frequency of 30 mc/sec., with a load resistance of 3900 ohms shunted by a capacity of 10 $\mu\mu$f. At the same time, the minimum effective damping resistance same time, the minimum e:ective damping resistance shall not be less than 2000 ohms.

REPRESENTATIVE CIRCUITS

The following circuits, while representative of a number of applications which are admirably suited to crystal diodes, do not pretend to be exhaustive. In Fig. 2 is shown a circuit in which a pair of Philips OA50s are used as a meter rectifier. Very often, it would be possible to dispense with the rectifier which is in shunt with the meter and the other rectifier, but when A.C. voltages of more than 60 volts or so are to be read, there is a danger that the negative A.C. peaks (in the circuit shown) will exceed the maximum continuous reverse voltage, and endanger the germanium diode. However, if a second rectifier is connected as shown, it will conduct on the negative peaks, and thus remove the greater part of the reverse voltage for the main diode. By the same token, the latter prevents the positive peaks from similarly endangering the shunt rectifier. In this way, it is possible to use the germanium diode for input voltages as great as 120 volts R.M.S. If higher multiplier resistors are used, the circuit will deal with inputs of many hundreds of volts without harm to the diodes.

NOTE ON TYPE OA61

This diode has been designed especially for D.C. restorer circuits. It has a minimum forward current at 1v. of 2.5 ma., an average forward current at the same voltage of 5 ma., and a reverse current at —50v. not greater than 100 A. This type is equivalent to the American type CK707.

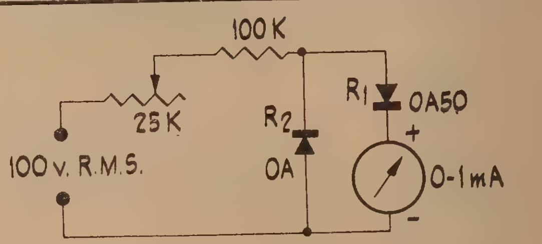


Fig. 2

Another useful arrangement is shown in Fig. 3, where an OA50 is used to energize a sensitive D.C. relay from an A.C. signal. Here, too, if the relay is a high-resistance one, and there is a danger of exceeding

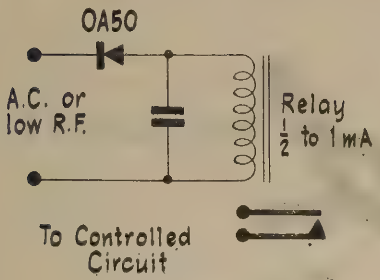


Fig. 3

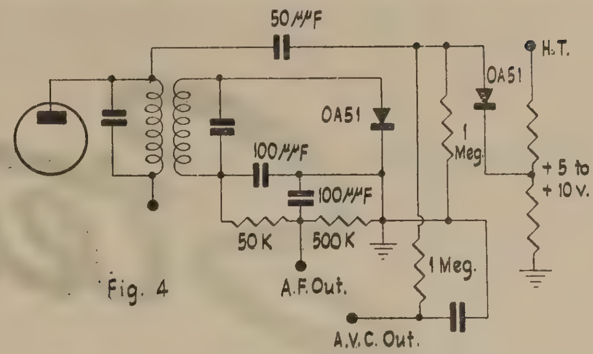


Fig. 4

the limit of the allowable reverse voltage, a second diode may be connected as in Fig. 2 in order to protect the rectifier diode. The function of the bypass condenser is to act in the same way as the input condenser of a conventional power rectifier system. It both increases the rectification efficiency, and also prevents the relay from chattering, in cases where the A.C. input signal frequency is low.

In Fig. 4 is illustrated the use of a pair of germanium diodes in the detector/A.V.C. section of a radio receiver. The circuit is identical with one that might be used with thermionic diodes, and yet there are one or two points which need to be watched if the circuit efficiency is to be high. The first is that an ordinary diode detector is a high-impedance circuit, and in such a circuit it is extremely important that the back resistance of the diode be as high as possible. When we use a valve diode, we do not have to worry about this, because its back resistance is as

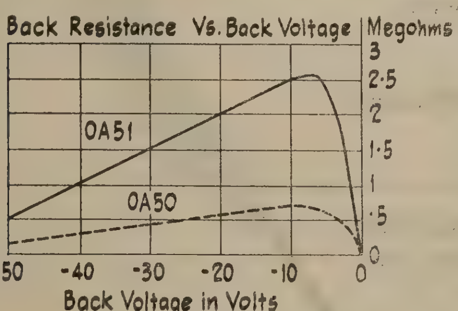


Fig. 5

nearly infinite as makes no difference. But if a diode is used which has a back resistance that is low in comparison with the D.C. load resistance, the detection efficiency is very much reduced, and the shunting on the tuned circuit which feeds the diode circuit is greatly increased. In this way, the available audio output from a given R.F. voltage at the grid of the last I.F. stage is much smaller than would be the case with a diode of infinite back resistance. It is thus important to use a germanium diode with the highest possible back resistance, and also to ensure that it is used under conditions which allow it to display this high resistance in the reverse direction. The latter remark is simply a re-statement of the fact that the back resistance of any diode is not a constant, but varies according to the signal voltage applied to it. This is shown by Fig. 5, which shows how the back resistance varies for two types, with variation of applied reverse voltage. It can be seen from this graph that each has a maximum back resistance at or slightly below 10 volts. Thus, for greatest detection efficiency, the applied signal voltage should be of this order. Now in order to attain this, an A.V.C. system should be used with a delay voltage of between five and ten volts. Thus, A.V.C. will commence to work when the peak signal voltage at the plate of the I.F. amplifier is equal to the delay voltage and thereafter as the signal at the aerial increases, the output I.F. signal changes only very little. In this way we see that the diodes are operated at the level which will give them their most favourable characteristics. The

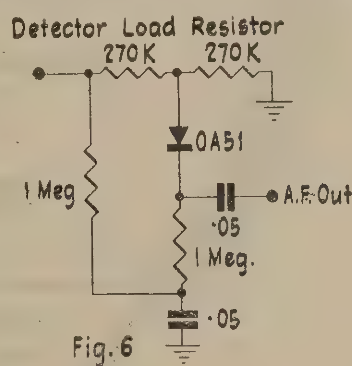


Fig. 6

shape of the curves in Fig. 5 shows that for voltages higher than that which gives maximum back resistance, this resistance declines only slowly, so that unless absolutely the best possible efficiency is required, it is only necessary to ensure that the back voltage is greater than the optimum figure.

If for any purpose it is necessary to secure high efficiency with a high-impedance load, and greater signal voltages than the optimum, one solution is to use two crystal diodes in series, as in Fig. 6. For example, if two OA51s are used in series, the maximum back resistance will be twice that for one diode, and the input voltage for maximum back resistance will be doubled.

In high-impedance circuits, the forward resistance of the diode is not of much importance. The requirement is that it shall be very much less than the

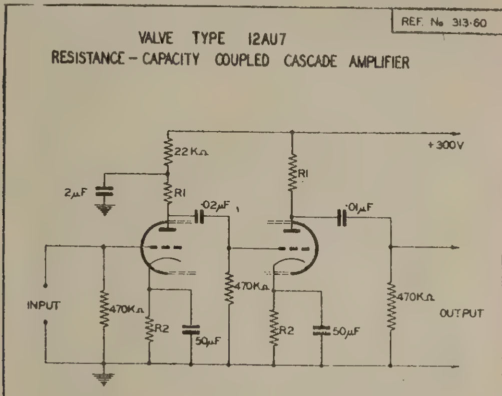
(Continued on Page 43.)

TUBE DATA—Receiving Tube 12AU7—Part 2

(By Courtesy of Brimar)

Cascade Resistance-Capacity Coupled Amplifier

The two triode units of the valve may be used in cascade if required, and no particular precautions are necessary to avoid instability. Grid and plate leads, however, should not be unduly long or close together and adequate plate supply decoupling is required.



RI (OHMS)	100,000	220,000
R2 (OHMS)	2,200	6,800
MAX. R.M.S. OUTPUT VOLTAGE AT 1Kc/s FOR 5% TOTAL HARMONIC DISTORTION	40	40
VOLTAGE GAIN AT 1Kc/s	174	155
GAIN AT 50c/s COMPARED WITH 1Kc/s (db)	−·35	−·35
GAIN AT 30Kc/s COMPARED WITH 1Kc/s (db)	−·35	−·85

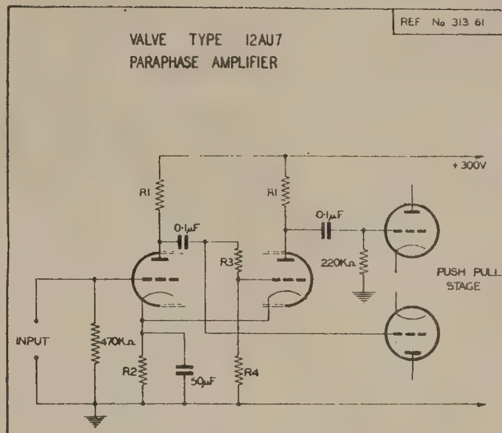
It is not recommended that a common cathode autobias resistor be used for the two units when operated in cascade unless a bypas condenser of very low reactance is employed. A circuit diagram is attached (No. 313.60) which indicates two sets of typical values, together with the figures of output voltage, gain, and frequency response. These figures indicate an output of approximately 55 volts peak, an overall voltage gain of the order of 150 and a frequency response within 1 db. from 50 cycles to 30 kc/sec.

Paraphase Amplifier

For many applications a push-pull output is required from an input having one side earthed and where it is not desired to use a transformer for obtaining the two phase output, such output can be conveniently obtained from a resistance-capacity phase splitting circuit. The valve is very suitable for this purpose and two circuits are described below.

(a) Normal Paraphase

The circuit attached (No. 313.61) shows a paraphase circuit in which one triode unit is fed from the output of the other unit in order to reverse the phase, the



RI (OHMS)	100,000	220,000
R2 (OHMS)	1,000	680
R3 (OHMS)	220,000	220,000
R4 (OHMS)	33,000	33,000
MAX. R.M.S. OUTPUT VOLTAGE GRID-TO-GRID AT 1Kc/s FOR 5% TOTAL HARMONIC DISTORTION	110	120
VOLTAGE GAIN AT 1Kc/s	12·2	10·9
GAIN AT 50c/s COMPARED WITH 1Kc/s (db)	−·33	−·15
GAIN AT 30Kc/s COMPARED WITH 1Kc/s (db)	−·66	−1 25

input being so adjusted that the gain is the same. Two sets of typical values are given, together with figures of output voltage, gain and frequency response. These figures indicate a push-pull output of approximately 150 volts peak for an input of 7 volts peak.

The condenser across the common cathode bias resistor may be omitted at the expense of the balance at the higher frequencies.

In this circuit the potentiometer tapping down the grid of the second triode unit is critical, and should be made variable if an accurate balance is essential.

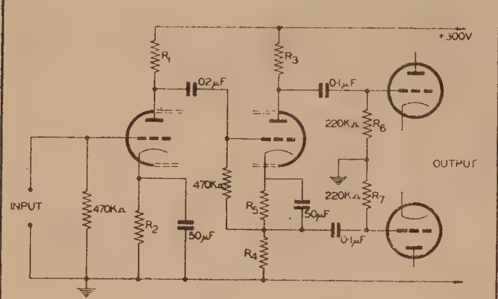
(b) Plate-Cathode Load Phase Splitter

In this application the push-pull output is obtained by dividing the load into two equal parts, one half being in the plate and one half in the cathode of the same triode unit; this triode unit gives no gain and the other unit is used as a straight amplifier before it. The circuit diagram attached (No. 313.62) gives a set of typical values, together with figures of output voltage, gain, and frequency response. These figures indicate a push-pull output of approximately 110 volts peak for an input of 9 volts peak.

The condenser across the cathode resistor of the second unit may be omitted if desired. Its removal results in only about 0.5 db. loss of gain, the frequency response is slightly improved, the balance in the bass is improved but the treble balance deteriorates and the maximum undistorted output is unaffected.

REF No. 313·62

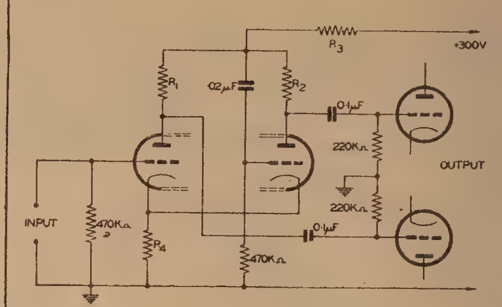
VALVE TYPE 12AU7
VOLTAGE AMPLIFIER & PHASE INVERTER



R1 (OHMS)	100,000	220,000
R2 & R5 (OHMS)	2,200	6,800
R3 & R4 (OHMS)	47,000	100,000
MAX. R.M.S. OUTPUT VOLTAGE GRID TO GRID AT 1Kc/s FOR 5% TOTAL HARMONIC DISTORTION	80	75
VOLTAGE GAIN AT 1Kc/s	12·1	10·4
GAIN AT 50c/s COMPARED WITH 1Kc/s (db)	−·7	−·25
GAIN AT 30Kc/s COMPARED WITH 1Kc/s (db)	−·85	−2·0

REF. No. 313·63

VALVE TYPE 12AU7
CATHODE & ANODE COUPLED



R1 (OHMS)	47,000	100,000
R2 (OHMS)	70,000	150,000
R3 (OHMS)	10,000	22,000
R4 (OHMS)	680	1,500
MAX. R.M.S. OUTPUT VOLTAGE GRID TO GRID AT 1Kc/s FOR 5% TOTAL HARMONIC DISTORTION	65	60
VOLTAGE GAIN AT 1Kc/s	11·4	11·0
GAIN AT 50c/s COMPARED WITH 1Kc/s (db)	−·55	−·6
GAIN AT 30Kc/s COMPARED WITH 1Kc/s (db)	0	0

In this circuit the accurate matching of R_3 and R_4 is essential, and, to a lesser extent, the matching of R_6 and R_7 if an accurate balance is required.

(c) Plate and Cathode Coupled Phase Splitter

In this application the push-pull output is obtained by connecting the cathodes of the two units together as shown in the circuit diagram attached (No. 313.63). The grid of the second unit is driven from part of the plate load of the first unit, R_3, which part is also common to the load in the plate of the second unit. Hence there is negative feed-back present in both plate and cathode circuits. Two sets of typical values are given together with figures of output voltage, gain, and frequency response. These figures indicate a peak push-pull output of approximately 90 volts for an input of 8 volts peak. This arrangement gives less output than the other types described, but the values of the resistances R_1 and R_2 and the succeeding valve grid leaks are not at all critical and may be to 20 per cent. tolerance without affecting the balance of the push-pull output. The resistance R_3 should be so chosen that balance is obtained and if R_3 is made variable an adjustable balance is realized. In this type of circuit, the balance is not affected by frequency.

Cathode Follower

Either triode separately, or both in parallel, may be employed as a cathode follower, but care should be taken not to exceed the maximum ratings.

Oscillator

The valve functions excellently as an oscillator either utilizing one unit or both units in push-pull or in parallel.

As an oscillator the plate voltage should not exceed 300 volts and the D.C. grid current of either unit should not exceed 5 mA. The power output from each unit in general will be of the order of 2.5 watts maximum depending upon the circuit and frequency. A curve (No. 313.25) shows the relationship between the power output obtainable and the frequency for both units as a push-pull oscillator.

Driven Amplifier

If this valve is employed as a driven Class C amplifier the maximum ratings must not be exceeded and neutralization will normally be required.

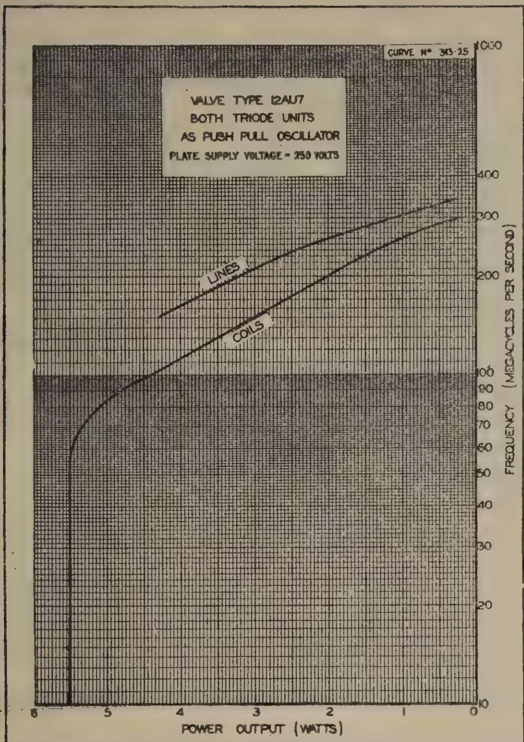
Frequency Multiplier

When used in this application the maximum ratings already given apply and within these ratings quite a useful output as drive to a succeeding stage is obtained. Below are typical operating conditions of one section as a frequency doubler, and as a frequency tripler, the fundamental input being obtained from the other unit as an oscillator or multiplier. When used for a low power transmitter or receiver frequency changer, the output is defined as a grid drive in mA in a stated value of grid resistor of the succeeding stage.

R.F. Doubler

Continuous ratings as a doubler without modulation:

D.C. plate voltage	250 volts
D.C. grid voltage	—108 volts
Grid resistor	47,000 ohms
Peak R.F. grid voltage	120 volts
D.C. plate current	16 mA
D.C. grid current	2.3 mA



Succeeding valve grid resistor	22,000 ohms
Succeeding valve grid drive	6 mA*

*Measured with typical coil doubling from 45 mc/sec.

R.F. Tripler

Continuous ratings as an R.F. tripler without modulation.

D.C. plate voltage	250 volts
D.C. grid voltage	—124 volts
Grid resistor	62,000 ohms
Peak R.F. grid voltage	140 volts
D.C. plate current	16 mA
D.C. grid current	2.0 mA
Succeeding valve grid resistor	22,000 ohms
Succeeding valve grid drive	2.5 mA*

*Measured with typical coil tripling from 30 mc/sec.

Television Receivers

The valve may be usefully employed in television time base circuits as combined frame and line squegging oscillators or as a combined frame oscillator and output stage if suitable circuits and frame scanning coils are employed. If necessary the two sections may be used in parallel in frame scan circuits of lower efficiency, or where more power is essential.

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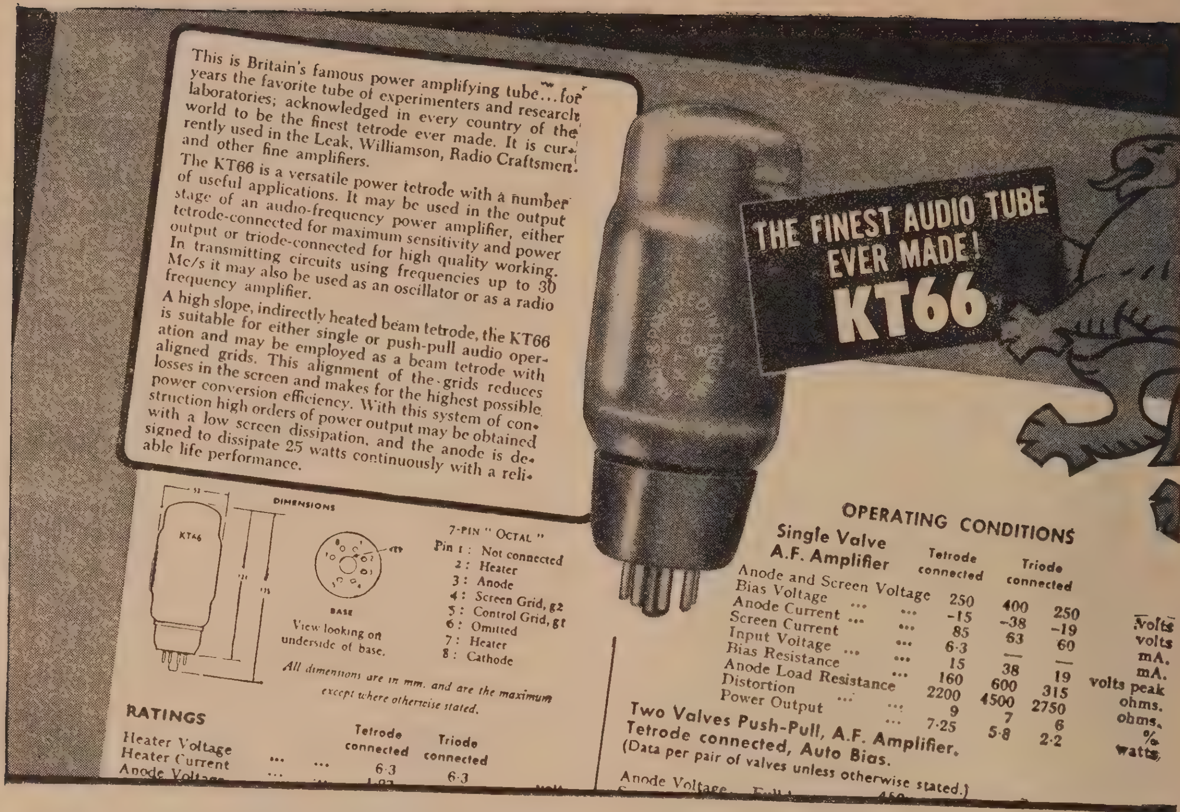

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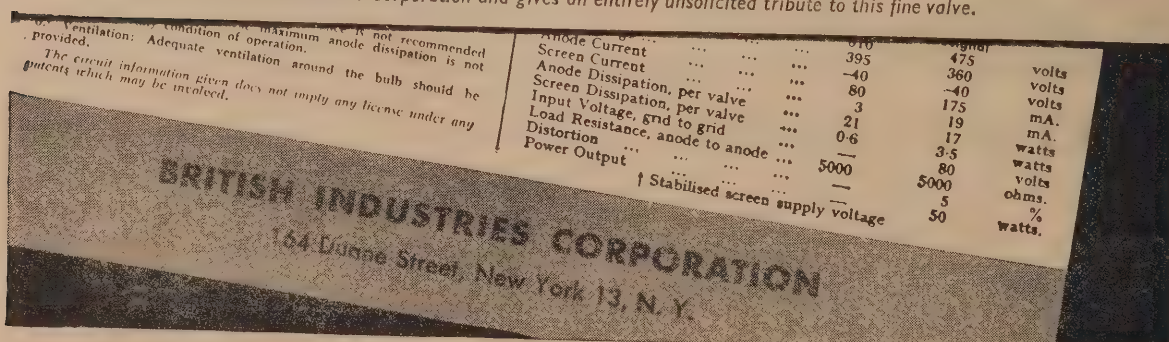

BRITISH GENERAL ELECTRIC CO., LTD.

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New Trends in Transmission Lines

By the Engineering Department, Aerovox Corporation

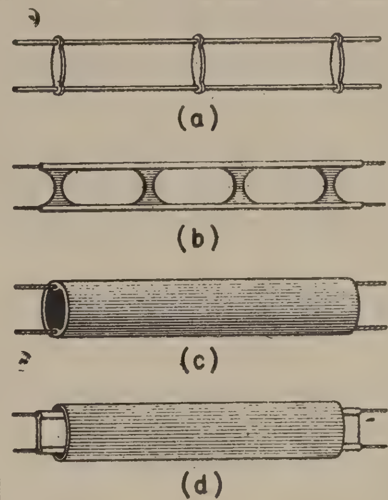
The engineering problem of transferring radio frequency power from one point to another by metallic conductors assumes more formidable proportions as the frequency involved increases. In the portions of the frequency spectrum which are presently being exploited for U.H.F. television, radio relay, radar, and amateur communications, the transmission lines commonly employed at low frequencies are no longer practicable. Open wire lines radiate excessively, with attendant high losses. Flexible solid dielectric coaxial lines may also prove excessively lossy, while solid conductor coaxial and and waveguide lines are too expensive for many applications. For these reasons, much research effort is being expended in developing efficient and economical substitutes for such transmission lines. This paper discusses some of the innovations which have resulted from this effort.

The conventional 300-ohm "twin-lead" employed as a standard in television practice has never been entirely satisfactory, even for V.H.F. low band use in certain conditions. During wet weather, excessive attenuation results from the formation of a moisture film on the web between the conductors. In coastal regions, where there is a high salt content in the fogs during storms, entire areas have undergone television "blackouts" for several days at a time due to the condensation of salt fog on the transmission lines. At such times, television service agencies are swamped with calls from customers demanding that their sets be fixed.

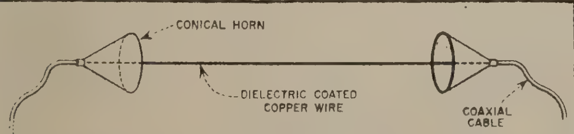
IMPROVED TWIN-LEADS

Several expedients have been adopted to alleviate the "fog-out" problem and other shortcomings of standard twin-lead. Considerable improvement over the solid polyethylene web line has been achieved by resorting to the use of high quality open-wire in which the conductors are moulded into spaced dielectric spreaders, as in Fig. 1 (a). High impedance line of the type long used in amateur practice (400-600 ohms), has only about one-tenth the loss of twin-lead in the low-V.H.F. channels. It is somewhat more difficult to handle, however.

The same end has been attained by removing most of the dielectric web material between the conductors of conventional twin-lead, leaving only a narrow spacer at intervals to maintain proper spacing, as in Fig. 1 (b). The approaches of Fig. 1 (a) and 1 (b) both minimize the leakage losses by removing as much of the leakage path between the conductors as possible. Of course, the spacing between the wires must be increased somewhat to maintain the same characteristic impedance when the continuous dielectric web is removed. This probably increases the losses due to radiation somewhat.



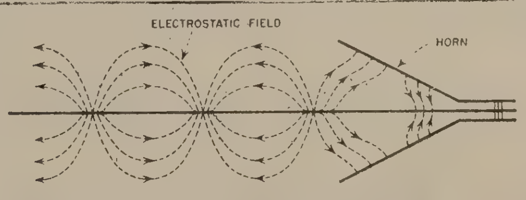
VARIOUS IMPROVED TWO-WIRE TRANSMISSION LINES
FIG. 1



ESSENTIALS OF SURFACE-WAVE TRANSMISSION LINE
FIG. 2

Another approach to loss minimization in two-wire line is illustrated in Fig. 1 (c). Here the two-wire conductors are moulded into diametrically opposite walls of a hollow polyethylene tube. Losses due to the precipitation of moisture on the line are reduced because the length of the leakage path is increased considerably. Dielectric losses, too, are lessened because the dielectric is now out of the high field region directly between the conductors.

Still another special form of twin-lead, similar to Fig. 1 (c) in principle, is that shown in Fig. 1 (d). In this variety, the condensation of moisture on the web between the conductors is avoided by covering the twin-lead with a plastic moisture sheath. The twin-lead may be of a solid web variety or may have part of the web removed, as in Fig. 1 (b).



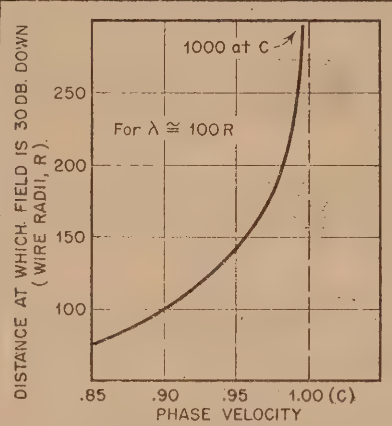
DISTRIBUTION OF SURFACE-WAVE ON WIRE
FIG. 3

Although the special open wire lines illustrated in Fig. 1 exhibit vastly improved performance for V.H.F. television applications, they leave much to be desired at frequencies above 300 megacycles. Even solid dielectric coaxial cables, such as the popular RG-8/U, become excessively lossy at U.H.F. television frequencies and almost out of the question for microwave use, except for short lengths. Its losses

are about 6 db. per hundred feet at the low end of the U.H.F. television band and rises to 8 db. at the high end (890 mc/sec.). At 3,000 mc/sec. this figure rises to almost 16 db., which means that only **one-fortieth** of the power entering one end of a hundred foot length reaches the other end. Such losses are prohibitive for most usage.

THE "G-STRING" LINE

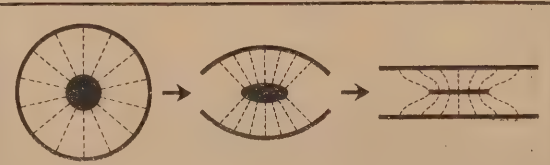
A new type of transmission system which may prove extremely useful in some applications has been pioneered by scientists of the U.S. Army Signal Corps and dubbed the "G-String," or, more aptly, a surafce wave transmission line. (Ref. 1). The elements of this system are shown in Fig. 2. The conductor is an ordinary single copper wire covered



DEPENDENCE OF SURFACE-WAVE CONCENTRATION UPON PHASE VELOCITY

FIG. 4

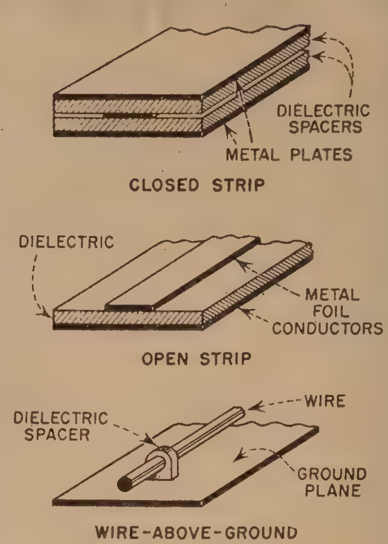
with a thin coating of a dielectric material. The special surface wave is launched on this wire by means of a conical horn, which is fed by coaxial cable. The arrangement is identical at the receiving end; a similar horn transforms the surface wave back into coaxial cable. A transmission line of this kind is capable of transmitting microwave energy with substantially less loss than the best solid dielectric coaxial cable. For example, at 1,000 mc/sec. the attenuation of a good surface wave transmission system is less than 2 db. per hundred feet, while RG-8/U approaches 9 db. for the same length.



EVOLUTION OF CLOSED-STRIP LINE FROM COAXIAL LINE

FIG. 5

The low losses of the "G-String" transmission line is attributed to the special configuration of the electro-magnetic wave launched on the single wire. Fig. 3 illustrates the assumed distribution of the surface wave on the wire. The electric field lines start on the wire and end on it, while the magnetic field lines are concentric circles around it. This wave is



THE NEW STRIP TRANSMISSION LINES

FIG. 6

prevented from radiating freely, as in a long wire antenna, by the dielectric film on the wire. This film serves to reduce the *phase velocity* of the wave and thus, to concentrate the fields of the wave closer to the wire. The reduction of the radiation is proportional to the thickness of the dielectric, but beyond a certain optimum thickness, the losses in the dielectric become as serious as the radiation losses. Therefore, for lowest losses, the dielectric coating is usually made only thick enough to reduce the phase velocity of the wave on the wire only a few per cent. below the velocity of light (c), which is the speed at which the wave would travel on a bare wire. For this small reduction the thickness of the coating is only a few thousandths of an inch. Actually, ordinary No. 12 enamelled copper wire was used in some of the early experiments with this means of transmission.

The manner in which the field is concentrated by control of the phase velocity is shown in Fig. 4. This shows the distance from the wire at which the field strength has fallen to 1/1000th of that at the surface of the wire, as a function of the phase velocity, for a system in which the wavelength is 100 times the radius of the wire. Note that for a velocity reduction of only 1 per cent. the field extends only about 250 times the wire radius (or about 2.5 wavelengths) from the wire, whereas at the velocity of light the wave extends four times that distance, and would radiate considerably more.

To launch a surface wave made with good efficiency and intercept most of the energy in it at the far end, the horns should be at least as large in diameter as the extent of the field indicated in Fig. 4. Thus, for a phase velocity of .90 (90 per cent. that of light), the horns should be about 2 wavelengths in diameter, 2.8 wavelengths for 95 per cent. of c, and 5 wavelengths for 99 per cent. of c. The space around the transmission line should be essentially free of reflecting obstacles within this same diameter. The supports for the line should be as nearly reflection-

less as possible. In addition, bends and sharp corners must be avoided, since the "G-String" is essentially a straight line transmission device. Corners can be negotiated by transposing back into coaxial line at the bend and then out again, using another pair of horns.

In as much as the diameter of the launching horns assume impractical dimensions for most V.H.F. television applications, little use for the surface wave transmission line is envisioned for this frequency range. However, in some special community television installations, where a signal from a large antenna on a hill must be transmitted hundreds or thousands of feet into a valley for distribution, this type of transmission line would be economically feasible. For U.H.F. television use, the same would apply, although at the high end of this band the use of a "G-String" for long lead-ins in standard installations might also be practical. The best application for this mode of transmission lies in the microwave region, however, where it is more economical than rigid coaxial or waveguide, has less weight and wind resistance, and can compete as far as losses are concerned.

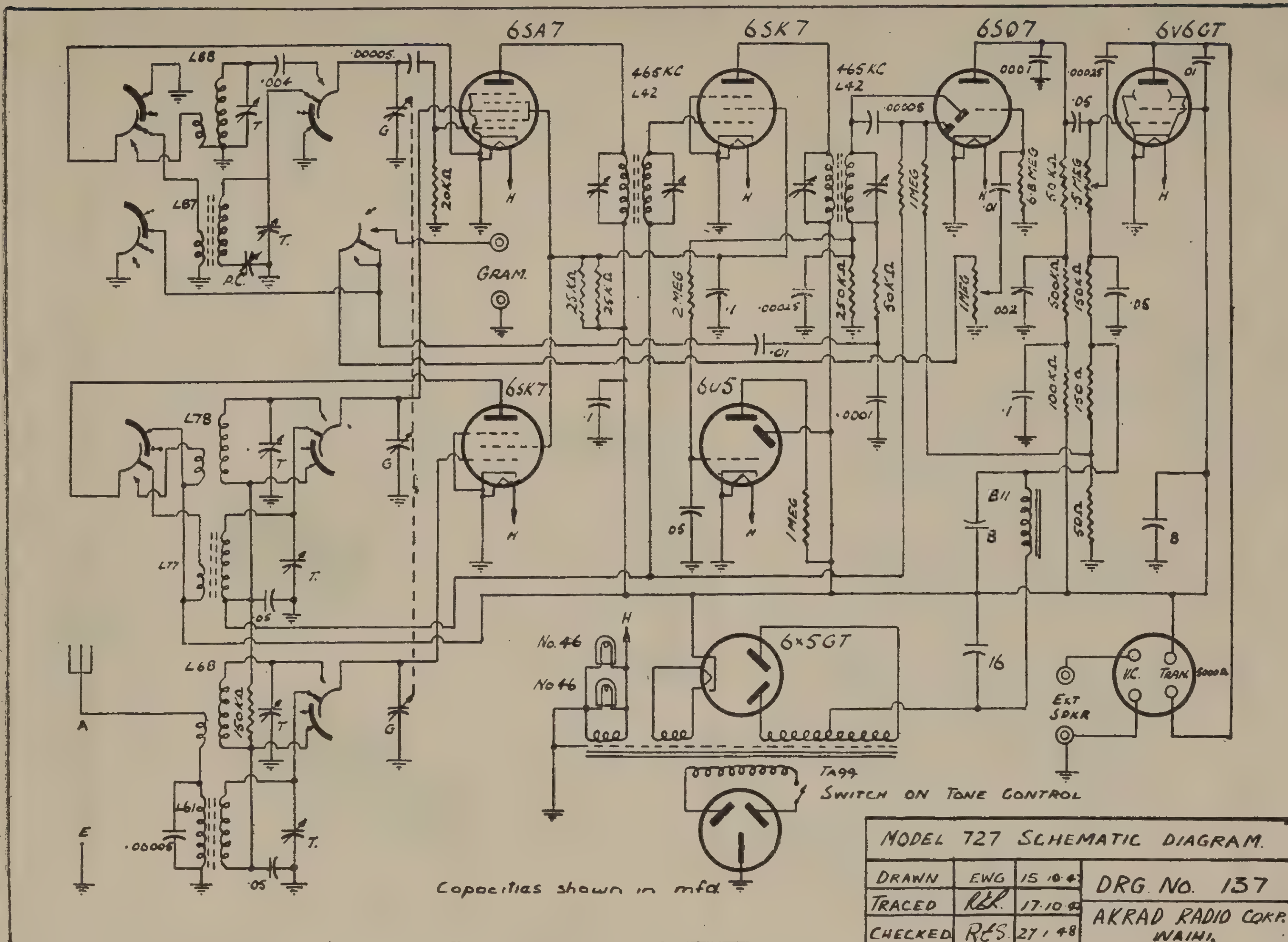
STRIP TRANSMISSION LINES

Another new family of transmission lines which are currently being pioneered are variously known as *planar, flat-strip, microstrip,* or *strip* transmission lines. These lines are evolved from ordinary coaxial line in the manner depicted in Fig. 5. Like the surface wave line, they are useful principally at microwave frequencies, where they show considerable promise for simplified and miniaturized components. Three types are in common experimental usage; *open-strip* line, *closed-strip* line, *and wire-above-ground* line. (Ref. 2, 3). These forms are shown in Fig. 6. The open-strip line and the wire-above-ground type may be thought of as being further evolutions of the closed-strip form, brought about by removing the upper strip. They are inferior to the closed-strip line in some respects, but are more desirable in others. These characteristics can be compared as follows:

(a) The *closed-strip* line exhibits the lowest losses from radiation since the fields are more completely confined between the outer conductors. These are usually made at least three times the width of the centre strip for effective field concentration. The Q of this line type is higher than the other two types, making it applicable for use in filter circuits and other components which require this property. Closed-strip line and circuit elements such as directional couplers power absorbers, power dividers, transitions, and slotted sections are easily fabricated by laminating the flat centre conductor between sheets of a low loss dielectric and, in turn, clamping this "sandwich" between the flat metal plates which form the outer conductors. Circuit components and lines of this type have also been built by the use of printed circuit techniques. Transitions between closed-strip line and coaxial cable are easily designed. Characteristic impedances up to about 200 ohms are practical.

(b) The *open-strip line* is less efficient than the closed type since the removal of the top ground

(Continued on Page 46.)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6SQ7
6V6GT
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No.46
No 46
TA94
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Wellington Radio Traders' Association

In his Annual Report presented to the Annual General Meeting of the Wellington Radio Traders' Association on 22nd July, the retiring President, Mr. W. L. Young, who did not seek re-election, commented on the increasing influence of the Association, due to its expanding membership, and urged individual members to help by encouraging all new traders to join.

The matter of meetings was one which had occasioned some concern, the most popular proving to be the semi-official functions, such as visits to radio transmitting stations, etc. Though little direct business was discussed on these occasions, members and their wives had an opportunity to meet socially, thereby promoting much goodwill throughout the trade.

From a trading point of view, Mr. Young considered that the year had closed on a very sound note. Retail sales in general seemed to be buoyant, and there had been a marked improvement in the sales of radio receivers during the past six months. Most traders had now made the necessary arrangements whereby they were able to operate within their permitted credit, and while these adjustments had not been easily made, business was proceeding as usual. Overseas currency restrictions had proved irksome and denied members needed goods which would have been readily acceptable to the buying public. On the other hand, however, there appeared to be a reasonable range of goods, though naturally Mr. Young felt that the traders' desired the public to obtain the latest and best at the keenest prices.

The sale of electrical appliances had now been brought within the scope of the Association, thus enabling members with particular problems concerning such marketing to enlist the aid of the Association. Such problems on a national basis would be referred to the New Zealand Radio Traders' Federation.

Though television has been a much discussed problem of late, and must undoubtedly come to New Zealand in due course, so far there has been little activity in this sphere from a trader's point of view. The announcement of Government policy concerning television in New Zealand is eagerly awaited by all concerned, but Mr. Young considered it unlikely, even if the matter is given most urgent attention, that New Zealand will see regular transmissions for at least two years. Though the sales possibilities of television receivers are boundless, traders should remember that, at present, their daily bread is earned by the merchandising of radios actually available for sale. Television as far as New Zealand is concerned, is still in the future, and traders should take care that it does not cloud the issue and detract from existing radio sales.

TRADE WINDS

TELEVISION FOR NEW ZEALAND

Mr. B. J. Edwards (left) Technical Director of Pye Ltd., Cambridge, England, with Mr. George Wooller, Managing Director of Pye (New Zealand) Ltd. inspecting Pye television equipment just before shipment to New Zealand for the television demonstration in the New Year.

It is interesting to note that the Pye TV equipment in the background is labelled for export to countries in all parts of the world—U.S.A., Japan, Belgium, New Zealand, Switzerland, Canada, Italy, and of course, the B.B.C.

* * *

LONG PLAYING RECORDS IN PRODUCTION

One of the most noticeable features of the long-playing record pressing section of the E.M.I. factory at Hayes, Middlesex, England, is its general cleanliness, so necessary to produce the plastic L.P. discs. Incidentally, these have to be made to much finer limits than the more familiar 78 r.p.m. shellac-based types.

The pressing shop is air-conditioned, smoking is forbidden, and great care is taken to avoid the entry or the formation inside of dust. Specially designed presses are used, and, in the case of the 33⅓ r.p.m. discs, finishing is carried out by a unit fixed to the side of the press, which automatically "turns" the edge of the pressed disc, removing the swarf, and leaving a highly polished rim. Unlike the shellac discs, grinding of the edges is not carried out.

Extreme care is taken with the completed discs. Actuauly, these are not handled at all, as any slight stain or finger mark on the record results in its being completely rejected.

U.S. CONTRACT FOR FERRANTI

Ferranti Ltd. of England, with the lowest bid of 857,600 dollars, has secured a contract from the United States Army for the supply of six transformers for the McNary Dam, on the Columbia River. Nearest U.S. competitor was a bid for 983,228 dollars.

* * *

NEW MULLARD C.R. TUBE FACTORY

As a result of the ever increasing application in industry of electronic devices and electronically controlled instruments, coupled with the very considerable increase in television, Mullard Ltd. has decided to estabilsh a new factory in North-west Lancashire for the manufacture of cathode-ray tubes.

It will be one of the largest and most modern television tube factories and will provide employment for hundreds of workpeople. The transfer of this work from Mitcham will make much-needed space available for the manufacture of other electronic devices.

* * *

H.M.V. CORONATION RECORDS

From the Gramophone Co. Ltd. comes the news of the recording of the Coronation service of Her Majesty, Queen Elizabeth II, on three 12 in. long-playing records (ALP1506/7/8). These records have a special red and cream label embodying a picture of Westminster Abbey.

Selected items from the service have also been recorded on four 78 r.p.m. records (DB21581/2/3/4), while the broadcast speech of Her Majesty has been issued on a 10 in. 78 r.p.m. record—DA2042.

A special Coronation Day Festivities record has been prepared in collaboration with the B.B.C. consisting of memorable moments of June 2. It is a 10 in. long-playing record (BLP1020).

Alas, as yet there is no news of these records reaching New Zealand.

* * *

MOBILE DECCA CHAINS

The March issue of Decca Navigator News describes an obvious, yet little publicized, use of a Decca Navigator system. To cover a desired area of a few thousand square miles in a part of the world not served by one of the existing permanent chains, transportable low-power transmitters are set up. Their principal use, so far, has been for hydrographic surveys, but the transportable chains have been employed successfully also on oil exploration in the Persian Gulf.

* * *

RADIO ON EVEREST ASSAULT

The conquest of Everest is still news, and every day brings more interesting information to light. There has never been any doubt of the important part played by radio during the assault. More important even than the exchange of information on climatic and climbing conditions, however, was the morale boosting effect of regular contact between the mountaineers and their colleagues at the base camp.

The decision to equip the expedition with portable radio transmitter-receivers was made only after lengthy tests had been carried out to prove the reliability of batteries small enough to fit into a mountaineer's waistcoat pocket, yet robust enough to perform in climatic

conditions ranging between high tropical humidity and sub-zero.

Tests carried out in the Vidor-Burndept laboratories showed that the small radio batteries weighing only $2\frac{1}{4}$ lb. used in portable radio sets would operate satisfactorily for 16 hours at a temperature of minus 10 deg. C. One battery, therefore, would allow 10-minute contact to be made 96 times. The batteries provided for the expedition were planned to give a total operational life of 530 hours at minus 10 deg. C.

The radio equipment used comprised miniature walkie-talkie sets weighing only 5 lb. supplied by Pye Telecommunications Ltd. These were six-valve V.H.F. transmitter receivers with crystal control, both send and receive, a device being used to obtain very high amplification from a single valve.

Most of the transmissions were made within the tents at night. The aerial fitted outside, while the operator conserved the life of the battery by speaking to the base whilst lying inside his sleeping bag. Because temperature played such an important part in determining the life of a radio battery, the mountaineers carried their batteries in special waistcoats designed to derive maximum body heat.

Pye also supplied the only other radio equipment in use, sets for the reception of the special weather forecasts broadcast for the expedition by the B.B.C. Overseas Service and All-India Radio.

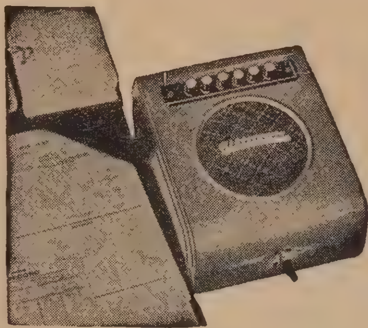
There has been much comment on the delay in news from the expedition getting back to Khatmandu and the outside world. As a matter of deliberate policy, however, the expedition took no radio equipment for communication out of the Himalayas. The main reasons for this were to conserve weight and to maintain their independence of outside advice or control.

BINDERS FOR "R. & E."

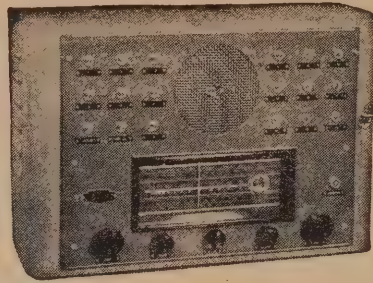
These are available to hold 12 issues—price 5s. 6d.

ULTIMATE

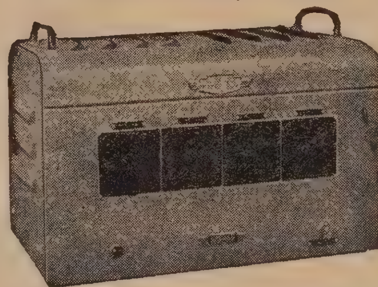
Industrial Communication Systems



Executive Intercommunicator



Sound Systems for Schools



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The "RADIO and ELECTRONICS" Abstract Service

AERIALS AND TRANSMISSION LINES

New transmission lines for V.H.F.: the conventional forms of lines are not satisfactory in these regions—open wire lines radiate excessively, flexible solid dielectric coaxial lines may be lossy and others too expensive. Certain new types of lines are illustrated showing twin conductor lines mounted in various ways. Some new "strip" types are also explained comprising metal strips mounted in various ways on dielectric mountings. The general principles are discussed.

—*Radio and Hobbies* (Aust.), July, 1953, p. 37.

Beating the noise problem: anti-noise aerials and gadgets are usually of no value whatever against atmospheric static, but noise limiting in the receiver can be successful. Man-made static however is a different matter and is preventable, and the methods of prevention are outlined. The article gives two useful appliances—the line filter for use on the mains, and an anti-noise aerial system. Full instructions for manufacture are given.

—*Ibid*, p. 76.

AUDIO EQUIPMENT AND DESIGN

The article describes a diminutive wire recorder almost small enough for the pocket—the German-made "Minifon." The wire used is only about .05 or .002 in. in diameter and its speed only 11.8 inches per second. Up to 2½ hours of material may be recorded on a single spool. A crystal diaphragm microphone and stethoscope type earphone are supplied with each recorder.

—*Radio and Television News* (U.S.A.), May, 1953, p. 38.

Why do identical audio systems sound different in different locations and why do records vary from disc to disc? The differences in records started a movement—playback equalization for everybody! The psychological and mechanical problems are discussed, and the fact emerges that nobody wants quite the same thing and must design the equalizer to his own requirements and taste. Records are not made for the pleasure of the laboratory recording instruments and herein lie the difficulties.

—*Ibid*, p. 39.

A detailed laboratory report on actual—not theoretical—performance of a small cabinet "Helmholtz" resonant-type loudspeaker enclosure. To speak of a given type of enclosure as a "Helmholtz" resonator does not put it in a class by itself—the fact is that all reflex baffles are Helmholtz resonators. The illustrations give examples of this analogy. An outline is given of baffle theory which helps to analyse objectively the properties of the enclosures, be they small, large, reflex, or horn.

—*Ibid.*, p. 43.

Simplified "push-pull" theory: a graphical, non-mathematical explanation of how second-harmonic and other even-order distion is cancelled or reduced in push-pull stages, and a discussion of why push-pull operation has no effect on third-harmonic or other odd order distortion.

—*Audio Engineering* (U.S.A.), May, 1953, p. 19.

A new approach to negative feedback design: a thorough discussion of the characteristics of individual amplifier stages and their relation to the over-all performance of a feedback amplifier. The subject is treated mathematically with the assistance of graphs and is a very comprehensive article for the designer.

—*Ibid*, p. 26.

CIRCUIT AND CIRCUIT ELEMENTS

How to design bistable multivibrators: these, as the term suggests, can remain quiescent indefinitely with either tube conducting and its opposite cut off, but if the circuit is modified by the addition of a triggering network, it may be switched from one stable state to another. The article deals with arrangements of flip-flop circuits for reliable operation despite adverse combinations of resistor deviations, supply voltage regulation and loss of tube emission. Guides are given for selecting the proper coupling capacitor and triggering network.

—*Electronics* (U.S.A.), April, 1953, p. 164.

Another vacuum tube keyer: the usual key click filter requires large components if any appreciable current is being broken, and an alternative is the vacuum tube keyer, also popular because it is shock proof. A circuit diagram is given of a crystal oscillator and vacuum-tube keyer using a 6AG7.

—*QST* (U.S.A.), May, 1953, p. 32.

ELECTRONIC DEVICES

A new material for increasing the reliability of computors is a ferrite (ferromagnetic ceramic) having a nearly rectangular hysteresis loop. Tiny ferrite toroids are used to store binary information. A flux change in any core in the array will induce a voltage on the output winding which threads every core. Voltages obtained by reading a one or zero from a single core are demonstrated. The storage units with access and read-out time of five microseconds or less make stored information rapidly available without scanning time required by other systems.

—*Electronics* (U.S.A.), April, 1953, p. 146.

A portable high speed stroboscope: a recently developed stroboscope is capable of giving up to 4000 flashes a second for high-speed photography, but is not sufficiently portable for many requirements. The instrument described uses a flash tube "scope" giving up to 500 flashes per second, and its circuitry and performance are given.

—*Electronic Engineering* (Eng.), June, 1953, p. 252.

INSTRUMENTS AND TEST GEAR

Physicists of the leading research laboratories have been giving increased attention to nuclear resonance during the past few years—a principle referred to in these pages of our last issue. The art has now advanced to the point where it is possible to construct engineering instruments based on the new principles. The apparatus described is used for the detection of isotopes—if the field and frequency are known, the isotope can be identified.

—*Electronics* (U.S.A.), April, 1953, p. 184.

The diagnosis of distortion: the diagnosis is made by examining an oscilloscope trace which represents all the defects of the apparatus which is being tested. By comparing the outline of this picture with certain standard shapes, examples of which are given, the various sources of distortion can be recognized. A pure sine wave signal is applied to the test object and also to the X-plates of an oscilloscope; the distorted signal is applied to the Y-plates after passing through a network which subtracts the pure fundamental wave and leaves only the distortion terms.

—*Wirelesss World* (Eng.), June, 1953, p. 251.

MATERIALS, VALVES, TRANSISTORS AND SUBSIDIARY TECHNIQUES

An interesting use of transistors is in trigger circuits. In introducing the subject the author has some far-reaching statements to make on the changes which transistors may make to the electronic sciences and to economics—he foresees a transistorized world. The trigger circuit is the key item of any digital device, it produces pulses, reshapes pulses, accepts them or rejects them. For these purposes a twin-diode has generally been used, but now the single or double transistor circuits are sweeping the board, and these are explained.

—*Ibid*, p. 256.

Improving the dry cell: to-day there is a world shortage of zinc and it is a matter of great importance that it should not wasted. The purpose of the article is to investigate the efficiency of the dry cell and to suggest ways in which its design, composition and construction might be improved. A second article will deal with the chances of using mains power to bring exhausted cells back to a useable condition.

—*Ibid.*, p. 278.

Designed to operate at the 1 kw. level in the 800 mc/sec. range, the multibeam electron coupler is an improved spiral beam modulation tube for use in U.H.F. television. The tube uses coaxial cavities and has five modulating electron beams in the output circuit.

—*Electronics* (U.S.A.), April, 1953, p. 130.

Energy levels in transistor electronics: fundamental principles of quantum physics, as they apply to transistors, are described in easy language for electronic engineers with a limited background in physics. Pertinent theories of Planck and Einstein are discussed. It is stated that an acquaintance with quantum mechanics is prerequisite to a thorough understanding of transistor electronics. Thus we go deeper and deeper as the science advances.

—*Electronics* (U.S.A.), April, 1953, p. 138.

The article deals with printed circuits and miniaturization. The bearing of foldable, three-dimensional circuits on the miniaturization of electronic equipment is emphasized, and the main features are pointed out.

—*Electronic Engineering* (Eng.), June, 1953, p. 234.

RECEIVERS

A short-wave converter for broadcast set: here is a simple unit which when connected between the aerial and your normal broadcast set will provide hours of fun for you from short-wave reception. The only modification required for your broadcast set is the bringing out of heater and high tension voltage for the unit.

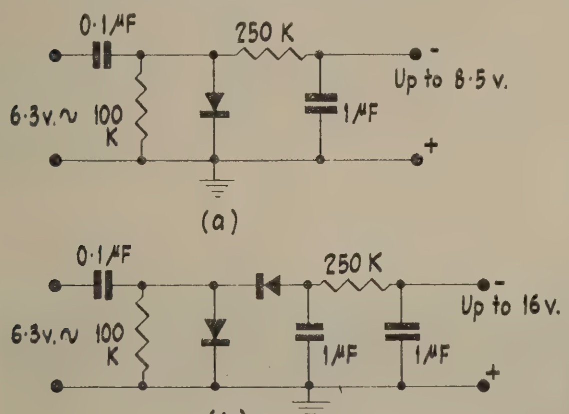
—*Radio and Hobbies* (Aust.), July, 1953, p. 73.

Philips Experimenter

(Continued from Page 24.)

resistance of the load. With germanium diodes, this is always the case—to an even greater extent than with valve diodes—so that even where two germanium units are used in series, the increase in forward resistance will have an unmeasurable effect on the detection efficiency.

In other similar circuits, such as noise limiters, it is important to have a high ratio of back to forward resistance, so that the choice of a type will resolve itself into finding the one which will give the best ratio under the signal conditions it will meet with in



(a) (b)
Fig. 7

the proposed circuit. For example, if the circuit of Fig. 4 is to be fitted with a third diode, to act as a series noise limiter, the requirements are for the greatest possible ratio of back to forward resistance at a signal level of one-half that imposed upon the detector diode. The circuit is given in Fig. 6, and the noise-limited diode is shown as a OA51, because not only does this type possess a ratio almost three times better than the OA50, but also a back resistance that is also higher in the same proportion. Thus, in spite of the fact that the back resistance of the OA51 falls off much more rapidly than that of the OA50 at low input voltages, the former is much the better type to use.

Sometimes, as in control circuits, it is necessary to rectify the output of an amplifier valve which has a very high plate load resistor, in order to apply the resulting D.C. voltage to the grid of a relay valve. In this case, too, it is most important to employ a diode with a very high back resistance. Take the OA50 as an example, fed from a 1 megohm resistor acting as the plate load for a DAF91 or similar valve. If it is tried, it would be found that owing to the low back resistance of about 0.6 megs. at an input of 5 volts, the amplification of the stage before the diode is very seriously reduced. Also the detection efficiency is very low with the necessarily high load resistor that must be used in such a case, with the result that the output from the detector is almost reduced to zero, in spite of the fact that before connecting it to the amplifier stage, there may have been a signal of about ten volts present across the 1 meg. plate load resistor

Many readers will remember the Synchrodyne detector circuit, developed several years ago as a means of giving almost any desired bandwidth with almost perfectly sharp selectivity outside the desired range. This requires a "ring" type detector circuit, which can be made up from two double thermionic diodes, or four germanium diodes. At that time, the latter were rather too expensive to make them desirable, while the valve diodes suffered from the fact that they introduced rather too much hum, as the output level was very low. Now this is a job just made for Philips germanium diodes, and types OA50 and OA56 are recommended as being very suitable. The circuit is a low-impedance one, and as well as their hum-free nature, the very low forward resistance of these diodes compared with their vacuum equivalents makes their detection efficiency considerably higher.

Another job that can be done by germanium diodes is that of providing power at very low levels. For instance, they would make excellent rectifiers in a low-voltage bias supply, such as those in Fig. 7. Of these (a) is a conventional half-wave shunt rectifier, while (b) is a voltage doubler circuit.

These represent only a few of the possible uses of germanium diodes. For things like absorption wavemeters, modulation monitors, and diodes for V.T. voltmeter probes they cannot be beaten. No modifications to circuits using conventional diodes usually need to be made, and for most purposes like these,

(Concluded on Page 48.)

Proceedings of the New Zealand Electronics Institute Incorporated.

At the first meeting of the Council of the New Zealand Electronics Institute Incorporated held at the new headquarters in Dunedin, the following officers were elected for 1953-54:—

Dominion President: Mr. H. F. Symmons, of the Physics Department, University of Otago.

Vice-President: Mr. W. L. Shield, of Radio Service Ltd., Dunedin.

Hon. Treasurer: Mr. E. S. Anderson of the Western Electric Co., Dunedin.

Secretary: Mr. A. Thornicroft, Public Accountant, 1 Dowling Street, Dunedin. (P.O. Box 546).

Councillors

Combined Branch: Messrs. W. G. Collett and A. R. Harris.

Christchurch: Mr. A. L. Gardner, S/Ldr. A. L. Partelow and the Immediate Past President, Mr. B. T. Withers.

Wellington: Messrs. J. D. McCormick and L. W. Hurrell.

Auckland: Mr. D. P. Joseph.

The following applications for membership of the Institute were approved:

P. J. Holden (Dunedin)—Associate Member.

A. Thornicroft (Dunedin)—Graduate.

G. T. Edgar (Dunedin)—Associate.

H. J. Southen (Wellington)—Transferred from Associate to Associate Member.

For the information of all concerned, the following are the names and addresses of the local Branch secretaries:—

Auckland: C/o Mr. D. P. Joseph, P.O. Box 5001, Auckland.

Wellington: Mr. W. E. H. Docherty, P.O. Box 5106, Wellington.

Christchurch: Mr. S. P. Willis, 1 Gamblins Road, Opawa, Christchurch.

Dunedin: Mr. E. S. Anderson, 4 Easther Crescent, Dunedin.

Among the items of a very large agenda, the Council approved a schedule of meeting dates for the year, and also adopted, for a trial period of three months, a set of standing rules for the conduct of Council business, which should ensure a great increase in efficiency and economy.

DUNEDIN

This Branch is expanding rapidly, and it is hoped that, at the next meeting of the Dominion Council, its eight new applications for membership and one regrading application will be approved.

At the conclusion of the general business at the July monthly meeting held in the Physics Department of the University of Otago, an illustrated lecture on the "15 MEV Harwell Linear Accelerator and Neutron Spectrometer," was delivered by Mr. E. R. Hodgson, M.Sc. Mr. Hodgson, who is attached to the Physics Department of the University of Otago, has just recently returned to Dunedin from Harwell.

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V.H.F. EQUIPMENT FOR FLAGSHIPS AT SPITHEAD

To enable flagships to be connected by radio link with the shore telephone exchange of C.-in-C. Portsmouth during the Spithead Review, special Pye equipment was installed on H.M.S. Surprise, H.M.S. Vanguard, H.M.S. Glasgow, H.M.S. Maidstone, and H.M.S. Dido.

In addition, the equipment in H.M.S. Vanguard was connected to the ship's telephone system so that callers on any telephone in the ship could communicate with C.-in-C. Portsmouth's telephone exchange, where three of these units were connected into the telephone exchange by line terminating units. This enabled simultaneous telephone conversations to be conducted with three ships at a time. The H.M.S. Surprise had an exclusive channel to prevent any delays. Amplitude modulation was used throughout.

This system enabled callers to be connected, via the telephone exchange of the C.-in-C. Portsmouth, into the normal G.P.O. telephone network, and Her Majesty, whilst on board either H.M.S. Surprise or H.M.S. Vanguard could communicate with any part of Great Britain.

Apart from ships of the Royal Navy, other ships tak-

(Concluded on next page.)

ing part in the Review and installed with Pye Marine V.H.F. equipment included the *British Sailor* 32,000 tons) the world's biggest tanker, owned by the British Tanker Company, the Anglo-Iranian fire-fighting tug *Zurmand* and an Anchor Line tug representing the British Tug Owners' Association.

Also present was Canadian ship *d'Urberville,* the most powerful ice-breaker in the world, which has been recently fitted with Pye radio telephone for communication with helicopters.

New Trends in Transmission Lines

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plane allows more radiation. It is considerably easier to construct, however, and can be made by printed circuit techniques or from commercially available metal-plastic-metal laminated materials by "stripping" the metal foil from one side to form the desired pattern. As with the closed-strip type, the ground plane "outer" conductor is made at least three times the width of the narrow strip. Transitions from coaxial to open-strip line are more difficult to manage and Q factors are lower. Typical dimensions for a 50-ohm open-strip line are: conductor spacing .050 inch, strip width .250 inch, and ground plane width, .750 inch.

(c) The *wire-above-ground* system is similar to the open-strip variety in that it is an unbalanced system which exhibits low Q because of higher radiation losses. It usually employs air as a dielectric and maintains the proper spacing above the ground plane by the use of dielectric beads at intervals. Its main advantages lie in its simplicity and its higher power handling capacity than the open-strip type because of the rounded conductor. It cannot be made conveniently by printed circuit methods. A typical 50-ohm line would consist of a 1/8 inch copper wire spaced .025 inch above a ground plane.

The losses in the new strip-type transmission lines are lower than those of solid dielectric cable but higher than rectangular waveguide with air dielectric. Their greater compactness, elimination of precision machining, and economy, are expected to make them very useful, especially for within-the-chassis microwave wiring where size reduction is important and the metal chassis can serve as the ground plane.

REFERENCES

(1) G. Goubeu, Jour. Appl. Phys., November, 1950.

(2) R. M. Barrett and M. H. Barnes, Radio and TV News, September, 1951.

(3) D. D. Grieg and H. F. Engelmann, Proc. I.R.E., December, 1952.

Sound Reproduction

(Continued from Page 11.)

figuratively holding our noses and talking learnedly about "one note bass" and "juke box thump." But I wonder how many of us go home and listen to our own system and wish it sounded as good "way down."

In the next part of this series we will discuss some attempts that have been made to get better bass from the home sound system.

Microgroove Records

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obtain. Just now, the reason, so far as our own country is concerned, is partly that there are not enough L/P discs to go round, so great is the demand, so that retailers just do not have the discs to spare, to earmark one of each record for demonstration purposes. Many of them do not get more than one copy of each, in any case, so that the problem is seen to be a serious one from many points of view.

In spite of this, we would remind everyone that the art of producing long-playing records is as yet in its infancy, and that it is no more likely to be a static one than any other art. Developments will undoubtedly come along which will remove many, if not all, of the present disadvantages of L/P discs. In the meantime, let us make the most of these records as we have them, and if we can see imperfections, hope that they will soon be remedied.

Philips Experimenter

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a detailed appraisal of the diode's characteristics need hardly be made. The diodes listed earlier in this article can all function at radio frequencies up to 100 mc/sec., and about the only thing that they are not really suitable for is for diode mixers in superhet receivers. Silicon crystals are much more suitable for this purpose. And while transistors are a much more spectacular development, it seems likely that the versatility and inexpensive nature of germanium diodes will bring them into much more general use than transistors for a number of years to come.

Lifesaver Sarah

(Continued from Page 14.)

also been on show to the U.S. Navy, the U.S. Army and the Royal Canadian Air Force. Only recently taken off the secret list, SARAH will shortly be submitted for approval at the next meeting of the International Convention for the Saving of Life at Sea.